VOL. XXXI. — No. 8. AUGUST 1954

Monthly Bulletin of the International Railway Congress Association

(English Edition)

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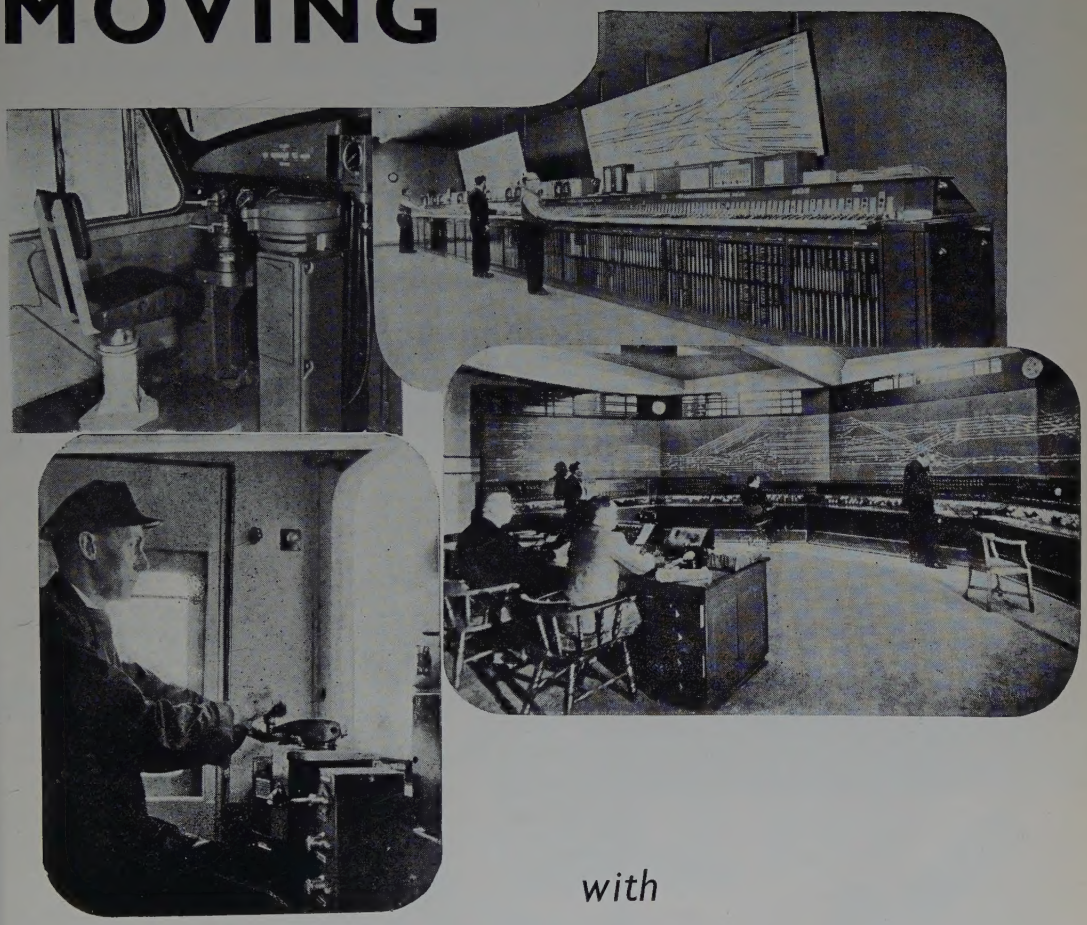

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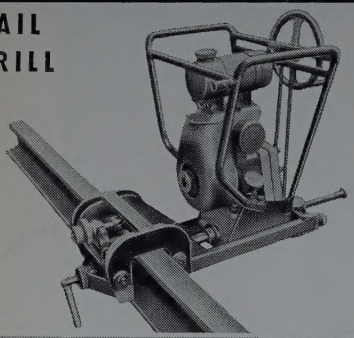

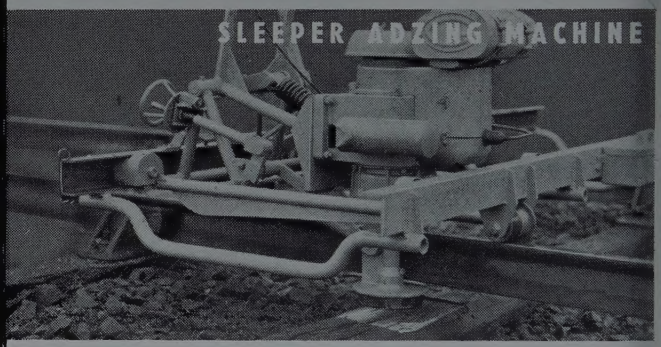

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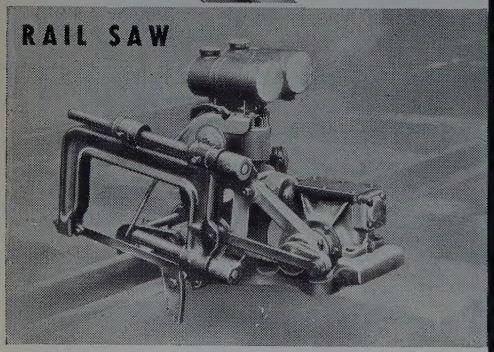

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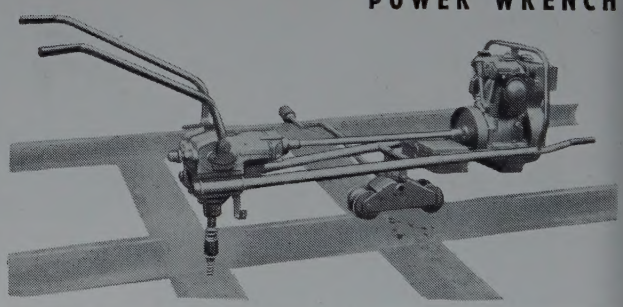

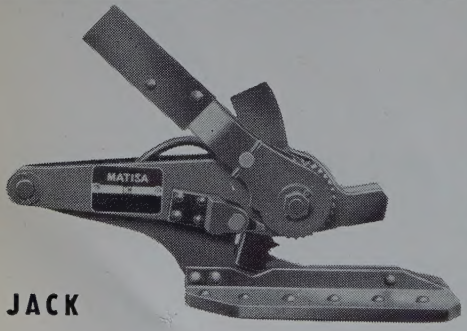

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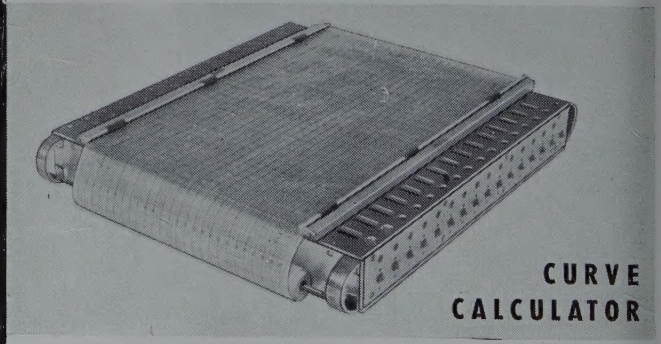

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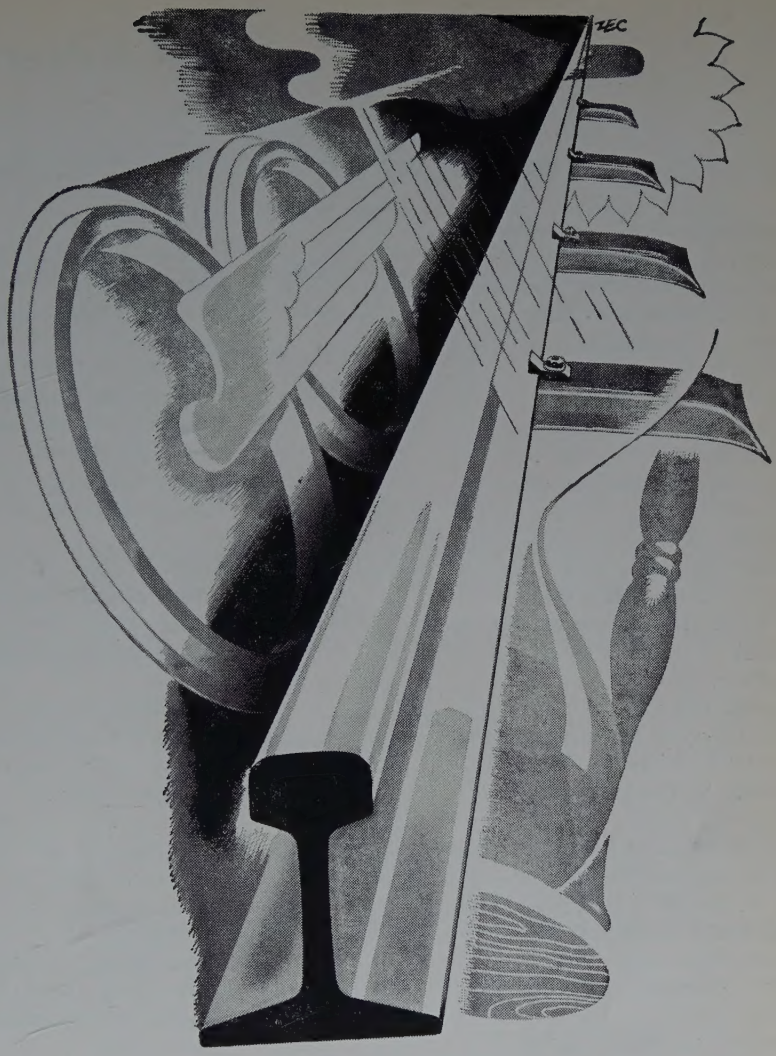

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BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

[656 .224]

The passing of frontiers by the international passenger trains,

by F. Lorriot,

Ingénieur en chef, Chef du Service Mouvement-Voyageurs
à la Direction du Mouvement de la Société Nationale des Chemins de fer français.

I. Historical.

Since the international services were resumed in 1946, the European Railway Administrations have recognised the need to improve the timetables of these services in view of the serious competition of other methods of transport; in particular, their attention has been drawn to the great deal of time the international passenger trains are forced to lose owing to the customs, police and exchange each time the frontier has to be crossed.

These controls are a very serious handicap to the railway compared with the aeroplane and the motor car.

In the case of air services, they take place on the aerodrome at the departure and arrival of each flight; they are very quick, since they only deal with a small number of passengers at a time, and the amount of luggage allowed is small.

In the case of the motor car, checks are made each time the frontier is crossed; but the number of passengers and amount of luggage is small in the case of each coach or motor car.

In the case of the railway, however, where several hundred passengers have to be checked together with their hand luggage and heavy luggage, the problem is a great deal more complex, and the possibilities of fraud are perhaps greater; in addition, as such controls have been in existence since the beginning of the railways, the Customs and Police Officials have got into the way of being more thorough.

The Management Committee of the U.I.C. was therefore led, as far back as 1949, to study this matter; a memorandum intended to serve as the basis for the establishment of an « International Convention to facilitate the crossing of frontiers » was adopted by the competent Committees and the Management Committee of the U.I.C., dated the 1st November 1950.

This proposal, which was first of all approved in its entirety on the 19th December 1950 by the European Economic Cooperation Organisation (O.E.C.E.) was then examined by the Internal Transport Committee of the European Economic Commission at Geneva.

As a result of the deliberations of the Railway Transport Sub-Committee in January 1951, at which representatives of the Governments, Customs Administrations, Police and the U.I.C. assisted, the European Internal Transport Committee approved the final text of an Inter-Governmental Convention which was submitted to the different European Governments for their signature.

This Convention was signed on the 10th January 1952 by representatives of the Belgian, French, Italian, Luxemburg, Swedish, Norwegian, Dutch and Swiss Governments; it came into force immediately; it is to be hoped that the other European Governments will agree to it in their turn.

The object of the present article is to comment upon the chief clauses of this Convention and report the results obtained to date.

II. The setting up of frontier stations with combined international controls.

When there is no agreement between the Governments of two neighbouring countries, the customs and police controls take place in two separate stations, one on each side of the frontier; the result is that the international trains have to stop twice, for about 45 minutes or an hour each time; this delay may even be longer if the passengers have to leave the trains to go through the customs in special offices at the frontier station.

The first improvement that can be made is to do away with one of these two stops and arrange for the controls carried out by each country to be made simultaneously in *one and the same station.*

Clause I of the Convention lays down the principles for such an organisation.

For this purpose :

— 1) In the station agreed upon by the two Governments, a zone is set up in which the Officials and Customs and Police Officials of the State in which this frontier station does not lie are authorised to check international passengers and their luggage travelling in either direction;

— 2) Inside this zone bi-lateral agreements are made by the two Governments concerned as regards :

a) the application of the Laws and Regulations of the other country as well as the powers, rights and obligations proper to the officials and employees of the competent Authorities of this country;

b) the offices required for the Administrative Departments of the other country;

c) the conditions under which equipment, lighting, heating and cleaning is to be carried out in these offices;

d) the organisation and working of the telephone connections;

e) the maximum number of officials and agents of the competent Administrations of the other country authorised to carry out the controls;

f) the conditions under which they may be recalled;

g) the conditions under which these officials can be armed and use such arms in carrying out their duties;

— 3) in principle, the controls should take place in the through coaches running on the international trains. With

this object, the Railway Officials should help to make such controls effective and speedy; they should cooperate in particular in preventing the passengers who are being checked from leaving the train or moving from coach to coach before the controls are completed.

These controls may only take place in the station waiting rooms in quite exceptional cases, when the Administration concerned considers this to be essential;

—4) the time the international trains remain in the station where the controls take place should not normally exceed 40 minutes for a train of 10 to 12 coaches; the time is reduced in the case of shorter trains, especially in the case of railcars;

— 5) when there is a currency control, the control operations should take place within the prescribed time and in such a way that they do not involve additional bother for passengers.

III. Police and customs control during the journey.

The setting up of combined controls at frontier stations is an important step forward; but not in any way final, as the International Convention recognises in its first clause.

The best solution in fact is to carry out all or part of the customs and police controls of the two neighbouring countries during the journey; this is the only way in which to reduce the time lost at the frontier to the time required for the railway formalities.

For this reason, in clause 9, the International Convention claims that the customs and police controls should take place to the greatest possible extent on the international trains themselves during the journey, provided such controls prove to be more effective and better for the passengers.

The fundamental condition laid down by the customs and police Administrations for the application of such a measure is that there should be either before or after the frontier station of each of the two neighbouring countries a *section run non-stop* by the international train in question *sufficiently* long for control formalities to be carried out in their entirity during this part of the journey, so that :

— *a*) after the departure controls have been carried out, the passengers can have no further contact with nationals of the country from which they have just come;

— *b*) before the entry formalities have been completed, passengers can have no contact with any nationals of the country to which they are going.

In addition, such controls during the journey must make it possible to reduce appreciably the time the international trains stop at the frontier stations; in the most favourable cases, it may even be possible to do away with such stops completely; naturally this would only be possible when the frontier station is not that of a large town with heavy passenger traffic and a great deal of shunting (Bale and Geneva for example).

The customs and police officials then carry out their checks in the territory of their respective countries; it may however happen that, particularly when it is

possible to do away with stopping an international train at the frontier station, that the officials of one country are carrying out their checks on the territory of the neighbouring country; in this case, a bi-lateral agreement determines the conditions under which the controls are carried out and the respective rights of the officials of the two countries, who as a result travel on the international train in question over the whole of the non-stop portion of the journey.

IV. Customs control of registered luggage.

When, as we have just reported, the customs and police controls take place during the journey, the control of the registered luggage takes place in principle during the running of the international train; naturally this train must be a corridor train throughout, so that access is possible to the front and rear luggage vans where the luggage is carried.

However, control of registered luggage during the journey is an exceptional operation and difficult to carry out; for this reason it is recommended that such luggage should be submitted to the customs (and other controls if there are any) at the departure station or at a large station en route before being loaded into the international train; such luggage is then not checked again by the officials of the departure country; it only has to be checked by the officials of the destination country. To avoid having to make these checks at the frontier station, which would involve a further delay, and consequently a fairly long stop for the international train, it is laid down that customs offices can be set up at stations with important international traffic inside the territory of the destination country.

The luggage is then transported between the internal customs stations under the regime known as « *International Transit* »; on journeys covered by this regime, special arrangements are made to guarantee the inviolability of the packages (sealing the compartments, vans, containers, baskets or saks in which such luggage is transported, or the sealing of the luggage itself after the preliminary establishment of an international customs declaration).

The International Convention lays down the conditions to be fulfilled for such sealings by the customs and the international customs declarations.

V. Chief realisations.

The tables appended sum up the principal realisations carried out according to the above International Convention.

Table I gives the principal frontier stations at which there are combined national controls.

Table II gives the runs on which passengers are checked during the journey.

Table III gives the internal Customs Stations for some countries.

As these tables show, certain countries, such as France, Switzerland, Belgium, have achieved the most favourable conditions as regards crossing their frontiers; other countries, such as Germany, Italy, Holland and the Scandinavian countries have made considerable progress; but there is still a great deal to be done, especially in Eastern Europe.

TABLE I.

Principal frontier stations with combined controls.

Frontiers	*Stations*
France-Belgium	Quévy-Jeumont
France-Germany	Kehl
France-Switzerland	Bale Porrentruy Pontarlier Vallorbe Geneva
France-Italy	Modana Ventimiglia
France-Spain	Hendaye (in the south-north direction) (1) Irun (in the north-south direction) (1) Canfranc Cerbère (in the south-north direction) (1) Port-Bou (in the north-south direction) (1) (1) for customs only
Germany-Belgium	Herbesthal
Germany-Denmark	Padborg
Germany-Switzerland	Bale Badoise
Germany-Austria	Salzburg-Kufstein Lindau-Passau
Switzerland-Austria	Buchs St. Margrethen
Switzerland-Italy	Chiasso Domodossola
Belgium-Holland	Rosendaal Visé
Austria-Hungary	Hegyeshalom
Austria-Italy	Brennere
Morocco-Algeria	Oujda

TABLE II.

Controls carried out during the journey.

Service	*Trains*	*Section on which the controls are carried out*
France-England	Golden Arrow	Paris-Calais
	Blue train	Amiens-Calais
	9/44	Paris-Calais
	61/62	Paris-Dieppe
	Train Ferry	Paris-Creil
France-Belgium	North Star	Paris-Brussels
	Blue Bird	—do—
	Other fast trains	Aulnoye-Mons
	North Express	Aulnoye-Charleroi
	179/182	—do—
	Lille-Brussels express	Lille-Tournai
France-Luxemburg	the chief international trains	Thionville-Luxemburg
	21/24	Longwy-Luxemburg
France-Germany	Orient-Express	Strasburg-Kehl
France-Switzerland	S O E	Frasne-Vallorbe
France-Italy	Paris-Rome	Chambery-Modana
France-Spain	South Express	police check between Bayonne and Hendaye
	1	police check between Biarritz and Hendaye
	Barcelona Express	police check between Perpignan and Cerbere
	1041	—do—
Germany-Denmark	North Express	Hamburg-Padborg
Germany-Belgium	North Express	
	Tauern Express	
Sweden-Norway	All the international trains	
Switzerland-Italy	—do—	Brigue-Domodossola
Austria-Switzerland	225	Langen-Buchs
Denmark-Sweden	All through coaches	Copenhagen-Malmö Helsingör-Helsingborg
Denmark-Germany	North Express	Fredericia-Padborg
Spain-Portugal	Lusitania Express	
Holland-Belgium	most of the international trains	Rotterdam-Roosendaal
—do—	34/35	Roermond-Visé
—do—	Most international trains	Eindhoven-Venlo
Morocco-Algéria	MA	Fès-Oujda

TABLEAU III.

Internal customs offices where the customs control of luggage can be carried out.

1° FRANCE

Colmar	Paris-St-Lazare	Dijon-Ville
Metz	Rouen-RG	Grenoble
Mulhouse-Nord	Bayonne	Lyon-Perrache
Nancy-Ville	Biarritz-Ville	Paris-Lyon
Paris-Est	Limoges-Bénédictins	Antibes
Reims	Paris-Austerlitz	Beaulieu-sur-Mer
St-Louis	Paris-Quai d'Orsay	Cannes
Strasbourg	St-Jean-de-Luz	Menton
Armentières	Toulouse-Matabiau	Monaco
Gravelines	Tours	Nice-Ville
Lille	Aix-les-Bains	St-Raphaël-Valescure
Paris-Nord	Chamonix	Marseille-St-Charles
Paris-Batignolles		

2° BELGIUM

Aalst-Noord (Alost-Nord)	Charleroi-Sud	Mechelen (Malines)
Antwerpen (Centraal, Oost, of Zuid)	Dendermonde (Termonde)	Namur
	Gent-St-Pieters (Gand-St-Pierre)	Oostende-Kaai (Ostende-Quai)
(Anvers Central, Est, Sud)		Rumes
Arlon	Kortrijk (Courtrai)	Stockem
Ath	Leuven (Louvain)	Tournai
Brugge (Bruges)	Liège-Guillemins	Treignes
Bruxelles-Midi	Liège (Longdoz)	Verviers-Central
Bruxelles-Nord	Liège-Vivegnis	Virton-Saint-Mard

3° GERMANY (Western)

Aalen	Cuxhaven	Hamburg-Harburg
Augsburg Hbf.	Darmstadt Hbf.	Hamm (Westf.)
Bacharach	Detmold	Hanau Hbf.
Baden-Baden	Dortmund Hbf.	Hannover
Bad Nauheim	Duisburg Hbf.	Heidelberg Hbf.
Bad Oeynhausen	Düsseldorf Hbf.	Heidenheim
Bad Pyrmont	Erlangen	Heilbronn Hbf.
Bad Reichenhall	Essen-Altenessen	Hildesheim
Bamberg	Esslingen (Neckar)	Hof Hbf.
Bayreuth Hbf.	Frankenthal	Idar-Oberstein
Berchtesgaden Hbf.	Frankfurt (Main) Hbf.	Itzehoe
Biberach (Riss)	Freiburg (Breisgau) Hbf.	Kaiserslautern Hbf.
Bielefeld Hbf.	Freilassing	Karlsruhe Hbf.
Bietigheim (Württ.)	Freudenstadt	Kassel Hbf.
Bingen (Rhein)	Fürth (Bay.) Hbf.	Kiel Hbf.
Bochum Hbf.	Garmisch-Partenkirchen	Koblenz Hbf.
Bonn	Gelsenkirchen Hbf.	Krefeld Hbf.
Braunschweig Hbf.	Giessen	Lahr Stadt
Bremen Hbf.	Göppingen	Landau (Pfalz) Hbf.
Bremerhaven Hbf.	Goslar	Lörrach
Bühl (Baden)	Göttingen	Lübeck Hbf.
Calw	Hagen Hbf.	Ludwigshafen (Rhein) Hbf.
Crailsheim	Hamburg-Altona	Lüneburg

TABLE III *(continued)*.

3° GERMANY (Western) *(continued)*.

Mainz Hbf.	Pforzheim	Trier Hbf.
Mannheim Hbf.	Pirmasens Hbf.	Tübingen Hbf.
Minden (Westf).	Radolfzell	Tuttlingen
Moers	Rastatt	Uberlingen
Mülheim (Ruhr)	Ravensburg	Ulm Hbf.
Müllheim (Baden)	Regensburg Hbf.	Villingen (Schwarzw.)
München-Gladbach Hbf.	Remscheid Hbf.	Waldshut
München Hbf.	Reutlingen Hbf.	Weil (Rhein)
Münster (Westf.) Hbf.	Rosenheim	Wetzlar
Neumünster	Rottweil	Wiesbaden Hbf.
Neustadt (Haardt) Hbf.	Schwäb Gmünd	Wilhelmshaven Hbf.
Nürnberg Hbf.	Schweinfurt Hbf.	Worms Hbf.
Oberhausen Hbf.	Solingen	Würzburg Hbf.
Offenbach (Main) Hbf.	Solingen-Ohligs	Wuppertal-Barmen
Osnabrück Hbf.	Speyer Hbf.	Wuppertal-Elberfeld
Palzem	Stuttgart Hbf.	

4° SWITZERLAND

Berne	Lucerne	Saint-Moritz
Bienne	Lugano	Thayngen-gare
Bonfol-gare	Morges	Les Verrières-gare
Chaux-de-Fonds	Montreux-Gare	Vevey-gare
Interlaken-gare	Neufchâtel	Winterthur
Lausanne-gare	Ouchy	Zermatt
Locarno	Schaffhouse	Zurich-gare principale
Le Locle-Ville	Saint-Gall	

5° ITALY

Ancona	La Spezia	Santa-Margherita-Ligure
Arona	Livorno	Siracusa
Bari-Centrale	Merano	Taranto
Bologna	Messina-Centrale	Torino-P.N.
Bolzano	Milano-Centrale	Trento
Brindisi	Napoli-Centrale	Trieste-Centrale
Catania-Centrale	Novara	Venezia-S.Lucia
Como-S.-Giovanni	Palermo-Centrale	Verona-P.N.
Firenze-S.M.N.	Roma-Termini	Viareggio
Genova-P.P.	San-Remo	

It is essential, if the Railways Administrations wish to maintain an international traffic worthy of the name, that they should all examine their own frontier posts, and, inspired by the methods reported in the present article, put into force such measures as will make it easy and agreeable to cross their frontiers.

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INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

16th SESSION (LONDON, 1954).

QUESTION 4.

Means and methods to improve the efficiency of steam locomotives :

a) increase of steam pressure,
b) types of grates,
c) superheating of the steam,
d) preheating of the feeding water,
e) feed water treatment,
etc.

SUPPLEMENT TO REPORT (*)

by C. T. Long,

Assistant Chief Mechanical Engineer (Motive Power), *South African Railways.*

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(*) See *Bulletin* for January 1954, p. 117. This supplement did not reach us in time for publication before the London Congress. The Special Reporter for this question, after a thorough study, pointed out in sectional meetings the most important points of this supplement and stated that in his opinion they did not make any changes necessary in the summaries of his special report.

ANNEXURES

Annexure number	*Particulars*	*Railway Administration*	*Section*
1 *	General characteristics of locomotives	Various	A
2 *	Particulars of superheated boilers	Various	A
A6 *	Weight of boilers in service per kg/h of steam produced	Various	A
A11 *	Characteristics of coal used	Various	A
A13	Section through firebox. Classes K, Ka, Kb . .	New Zealand Railways	A
A14	Section through boiler. Class Y6b	Norfolk and Western Railway	A
B10	Air openings through grates and into ashpans .	Various	B
B11	Arrangement of rocking grate. Class 7.	British Railways	B
B12	Firebar.	British Railways	B
B13	Arrangement of brick arch. Class 4	British Railways	B
B14	Grate arrangement. Classes K, Ka, Kb . . .	New Zealand Railways	B
B15	Arrangement of grate and Franklin mechanical grate shaker.	Norfolk and Western Railway	B
B16	Arch brick arrangement. Class Y6b	Norfolk and Western Railway	B
C3 *	Characteristics of cylinder lubricating oils . . .	Various	C
C4	« Melesco » steam dryer	British Railways	C
C5	Semi-plug piston valve (10″)	British Railways	C
C6	« United Kingdom » piston rod packing . . .	British Railways	C
G12	Characteristic curves for the exhaust etc . . .	British Railways	G
G13	Relationship between blast pipe and chimney sizes	British Railways	G
G14	Smokebox arrangement Classes SI and SIa .	Norfolk and Western Railway	G
G15	Smokebox and superheater arrangement. Class J	Norfolk and Western Railway	G
G16	Smokebox and superheater arrangement. Class Y6b	Norfolk and Western Railway	G
G17	Smokebox arrangement. Class 7	British Railways	G
G18	Smokebox arrangement «Merchant Navy» class	British Railways	G
G19	Blast pipe. « Merchant Navy » class	British Railways	G
M5	Tests of classes 7 and 4 on stationary testing plant.	British Railways	M
M6	Dynamometer road tests of classes A, J and Y6b	Norfolk and Western Railway	M

Note. — Annexures marked thus (*) correspond to similarly numbered Annexures in the Main Report.

UNITED KINGDOM OF GREAT BRITAIN

British Railways.

NEW ZEALAND

New Zealand Government Railways.

UNITED STATES OF AMERICA

Norfolk and Western Railway.

A. INCREASE IN STEAM PRESSURE.

a) *Increase in pressure, if any, and reasons.*

British Railways report that the range of boiler pressures which best suit requirements is 200 to 250 lbs. per sq. inch (14.06 to 17.58 kg per sq. cm), covering an establishment of about 9 000 locomotives. The boiler pressure is determined in relation to cylinder diameter, which in itself may be dictated by considerations of space available within the loading gauge. The higher pressures become necessary in the larger locomotives but pressure is kept down to reduce the boiler maintenance. It is pointed out that there is little advantage in respect of thermal efficiency by exceeding pressures of 200-250 lbs. per sq. inch (14.06-17.58 kg per sq. cm) in the case of locomotives with simple expansion.

The British Railways have given particulars of two classes of locomotives with a boiler pressure of 280 lbs. per sq. inch (19.7 kg per sq. cm). Both are simple expansion locomotives, the one class being equipped with three cylinders and the other with two cylinders. It is reported that a class of locomotive with 280 lbs. per sq. inch (19.7 kg per sq. cm) working pressure is out of service on approximately 50 % more days per annum than a similar class of locomotive working at 225 lbs. per sq. inch (15.18 kg per sq. cm) although it is conceded that the class with the higher boiler pressure would be generally employed on more arduous duties than the class with the lower pressure.

The period between external boiler examinations for locomotives with pressures of 180-250 lbs. per sq. inch (12.66 to 17.58 kg per sq. cm) varies from 2 to 6 months, but locomotives working at a pressure of 280 lbs. per sq. inch (19.7 kg per sq. cm) are examined every two months, and are washed out every 7-8 days, except where special methods of water treatment are in operation. At each washout special attention is paid to the build-up of soot and slag on firebox surfaces and superheater elements. If this is not done the large tubes tend to block up very rapidly.

The British Railways also report that the higher boiler pressure results in the lead in fusible plugs deteriorating more quickly than at lower pressures and that lead joints, where fitted on mudhole doors, are found at washout to be very thin. The same difficulty is not experienced with asbestos joints.

The New Zealand Government Railways reports that at about 190° the prevailing boiler pressures were 170 to 175 lbs. per sq. inch (12.05 to 12.3 kg per sq. cm). Present day locomotives work at 200 lb. per sq. inch (14.06 kg per sq. cm). Standard boiler mountings, etc., are designed for this pressure and as it has been possible to design locomotives with the desired tractive effort at this pressure, it is not considered that economics which might be secured with higher pressures would compensate for the expense of introducing and stocking a new range of fittings.

On the Norfolk and Western Railway all modern switching locomotives, which are hand fired, work at 220 lb. per sq. inch (15.47 kg per sq. cm). All the modern open line locomotives work at 300 lb. per sq. inch (21.10 kg per sq. cm). Certain of the earlier locomotives have had the pressure increased to this figure from 275 and 280 lb. per sq. inch (19.34 and 19.7 kg per sq. cm).

This Railway reports that although, with the classical type of boiler, it has not been absolutely determined above what pressure the increase in maintenance costs cancels out the advantage of increased boiler output it would seem that 300 lb. per sq. inch (21.10 kg per sq. cm) approaches that limit.

No special methods have been adopted for the repair and maintenance of boilers in relation to the increase in pressure nor has the increase in pressure led to any variations in the standards for the periodical tests of boilers.

b) *Characteristic boiler data.*

Characteristic boiler data for the three Railways now being dealt with is shown in Annexure No. 2 attached to this addendum.

In so far as the British Railways are concerned the boilers used are of orthodox design and the only features which may be described as special are the steel fireboxes and thermic syphons fitted to 140 locomotives of the « Merchant Navy » and « West Country » classes.

New Zealand Government Railways locomotives have for many years been fitted with boilers of the conventional round top type, with radial stays, wide firebox and steel inner firebox. To burn the sub-bituminous coal which is used extensively the Administration states that the grate area is somewhat larger than is usual for locomotives of comparable size.

The New Zealand class « KG » locomotives are equipped with two Nicholson thermic syphons to meet the additional steam demand of boosters with which this class of locomotive is equipped. Classes « K » and « KA » locomotives, not equipped with boosters, are identical except for the fact that the boilers are not fitted with syphons.

All boilers used by the Norfolk and Western Railway are of the radial stay type. Longitudinal arch tubes are used on most of the classes A, J, Y5 and Y6 locomotives and transverse arch tubes are used on some of the classes Y6 and on one class J. The more recent locomotives of the classes A, Y6b, and J are equipped with circulators. Fifteen of the class SI locomotives are equipped with two thermic syphons, while the remaining 60 SI's and SIa's are equipped with two circulators.

On the class Y6 locomotives, originally built with combustion chambers 0.943 m long (approximately 37″), the chambers are being lengthened to 2.143 m (approximately 84 1/2″). Tests have shown that although the boiler with the longer combustion chamber has 71.81 sq. m (770 sq. ft.) less evaporative area due to shorter tubes than the boiler with the shorter combustion chamber, the boiler efficiency is higher and, furthermore, maintenance costs are lower due to less cinder cutting of the tubes.

c) *Materials used in boiler construction.*

Classes of materials used in boiler construction are given in Appendix II, while brief particulars of the British Railways Specifications referred to are as follows:

Specification No. 110. Steel boiler plate (ordinary quality). The provisions of the specification are generally in accordance with British Standard 24, Part 6, Specification 16, for plates other than firebox plates.

The methods of testing, and types of test pieces, are those prescribed in British Standard 18: Tensile Testing of Metals, Test Piece « A ».

The plates are made of best quality steel produced by the Acid or Basic Open Hearth or Electric process, as stipulated when ordering, and must not contain more than 0.050 % sulphur or phosphorous.

Specification No. 111. High tensile steel boiler plates.

The methods of testing, and types of test pieces, are prescribed in British Standard 18: Tensile Testing of Metals, Test Piece « A ».

The plates are made of steel of the best

quality produced by the Acid or Basic Open Hearth or Electric Process, as stipulated, and must comply with the following analysis:

Carbon	0.23 % max.	Phosphorous	0.05 % max.
Silicon	0.10 to 0.35 %	Nickel (optional)	0.40 % max.
Manganese	1.30 to 1.70 %	Chromium (if present)	0.25 % max.
Sulphur	0.05 % max.		

The plates are supplied in the normalised or « as rolled » condition, as specified.

The mechanical properties of the steel are as follows:

Ultimate Tensile strength	34 to 38 tons per sq. inch.
Yield stress not less than	50 % of ultimate stress.
Elongation	20 % minimum on a gauge length of 8 inches.

Specification No. 301. Copper plates for locomotive fireboxes. The plates are required to comply with the conditions laid down in British Standards Report 24, part 5, Specification 11 and are to be manufactured from phosphorous de-oxidised arsenical copper, the composition being to British Standards Specification No. 1174.

The high tensile steel plates to B. R. Specification No. 111 are used in the larger boilers as a means of saving weight.

The New Zealand Government Railways use the following steels:

Firebox and combustion chamber: Extra soft firebox steel (Lukens or Colvilles' Double Crown).

Smokebox: Steel to British Standard Specification . . . . . 24/6/17.

Barrel: Steel to British Standard Specification . . . . . 24/6/16.

Staybolt steel is to the following specification, which follows United States practice, there being no corresponding British Standard Specification.

Chemical Composition:

Carbon	0.10 % max.
Sulphur	0.05 % max.
Phosphorous	0.05 % max.
Manganese	0.30-0.60 %
Nickel	2.00-2.50 %

Physical Properties:

Ultimate strength	25 tons per sq. in.
Yield point	16 tons per sq. in.
Elongation on 2″	35 % minimum
Reduction of area	65 % minimum
Bend test	Through 180°

It has been reported that this staybolt steel gives much better service than non-alloy steel.

On the Norfolk and Western Railway all boiler and firebox sheets are carbon steel conforming to AAR Specifications. No special steels are used.

On the British Railways thicknesses of boiler plates are based on a factor of safety of 5 on the ultimate stress, although a slightly lower figure is tolerated when this saves using a plate of 1/16″ (1.59 mm) greater thickness.

The following examples are quoted:

	First barrel ring	*Second barrel ring*	*Minimum factor of safety*
Class 7	19/32″ (15.1 mm)	21/32″ (16.7 mm)	4.87
Class 4	9/16″ (14.3 mm)	5/8″ (15.9 mm)	4.82
S.R. Merchant Navy.	21/32″ (16.7 mm)	21/32″ (16.7 mm)	4.95

The Norfolk and Western Railway gives the following thicknesses of plates for classes A, J, and Y6b locomotive boilers, all of which work at 300 lbs. per sq. inch (21.09 kg per sq. cm).

	Class A	*Class J*	*Class Y 6b*
First course	28.6 mm (1 1/8″)	27.0 mm (1 1/16″)	29.4 mm (1 5/32″)
Second course. . . .	28.6 mm (1 1/8″)	30.2 mm (1 3/16″)	30.2 mm (1 3/16″)
Third course	31.0 mm (7/″8)	22.2 mm (1 7/32″)	31.0 mm (1 7/32″)
Fourth course. . . .	25.4 mm (1″)	—	23.8 mm (15/16″)
Roof sheet	25.4 mm (1″)	22.2 mm (7/8″)	26.2 mm (1 1/32″)
Outside side sheets. .	12.7 mm (1/2″)	12.7 mm (1/2″)	12.7 mm (1/2″)
Backhead outside . .	12.7 mm (1/2″)	12.7 mm (1/2″)	12.7 mm (1/2″)
Firebox side sheets, crown sheet, combustion chamber sheets	9.5 mm (3/8″)	9.5 mm (3/8″)	9.5 mm (3/8″)
Throat sheets, outside	22.2 mm (7/8″)	22.2 mm (7/8″)	22.2 mm (7/8″)
Throat sheets, inside	12.7 mm (1/2″)	12.7 mm (1/2″)	12.7 mm (1/2″)
Back flue sheet . . .	12.7 mm (1/2″)	12.7 mm (1/2″)	12.7 mm (1/2″)
Front flue sheet . .	19.1 mm (3/4″)	19.1 mm (3/4″)	19.1 mm (3/4″)
Smokebox	15.9 mm (5/8″)	15.9 mm (5/8″)	15.9 mm (5/8″)

d) *Characteristics of the fuel used.*

With one exception all British Railways locomotives are coal fired, while on the New Zealand Government Railways a number of locomotives are oil fired, although coal fired locomotives predominate.

All the Norfolk and Western locomotives consume coal.

Annexure A.11 (addendum) gives the characteristics of the coals used by these three railways, in addition to which the following information has been recorded.

The British Railways classify the three types of coal shown in the annexure as:

South Kirby : best quality Yorkshire hard coal;

Blidworth : intermediate quality hard coal;

Bedwas : intermediate quality South Wales high carbon coal.

The New Zealand Government Railways give the ultimate analyses as follows:

Source	Bituminous coal mined	Sub-bituminous coal	
		open cast	mined
Mine	Millerton	Glen Afton	Wilton
Ultimate	%	%	%
Analysis :			
Carbon	83.3	75.9	73.9
Hydrogen	5.6	5.3	5.1
Nitrogen	1.0	1.2	1.1
Sulphur	3.5	0.4	1.8
Oxygen	6.6	17.2	18.1
Swelling No.	9	non-coking	non-coking
Calorific value	13 960 B.T.U/lb	10 470 B.T.U/lb	10 380 B.T.U/lb
Ash analysis :			
Silica	47.40	30.90	10.15
Alumina	38.43	9.84	4.13
Ferric oxide	5.63	8.80	34.30
Lime	1.44	28.04	21.49
Sulphur trioxide	.85	8.77	23.07
Boric oxide	.08	3.02	2.83
Remainder	6.17	10.63	4.03
Fusion temperature	over 1 580° C	1 120° C	1 200° C

The Norfolk and Western Railway classify the coals used as high volatile bituminous coal, which is used in road service, and low volatile bituminous coal as used in switching service.

The sizes of the two coals, as used, are given as :

	High volatile	Low volatile
Passing 0.32 cm (1/8″) screen	2.48 %	3.68 %
» 1.27 cm (1/2″) »	7.76 %	5.69 %
» 3.18 cm (1 1/4″) »	35.02 %	64.60 %
» 4.45 cm (1 3/4″) «	23.51 %	23.33 %
» 5.08 cm (2″) «	28.75 %	—
» 7.62 cm (3″) »	1.54 %	—

e) *Future trends in increased boiler pressure.*

The British Railways do not propose departing from the present range of boiler pressures of 200 to 250 lb. per sq. inch (14.06 to 17.58 kg per sq. cm) for new locomotives while the New Zealand Government Railways are satisfied with the present maximum pressure of 200 lb. per sq. inch (14.06 kg per sq. cm).

The Norfolk and Western Railway do not propose to increase the present maximum pressure of 300 lb. per sq. inch (21.10 kg per sq. cm), which they consider to be about the optimum pressure with the classical type of boiler.

SUMMARY.

No amendment to the summary in the main Report, except that it is of interest to note that the Norfolk and Western Railway are using a boiler pressure, which is regarded as the optimum, appreciably higher than the pressures either used or aimed at by other Railways reported upon.

B. TYPES OF GRATES.

a) *Development of types of grates.*

British Railways report the rocking grate, having unit bars of the grid type, as the type of grate which gives the best results, and it is claimed that the grid type of bar becomes less clogged than the Hulson type, which has smaller air passages.

The type of grate referred to above is fitted to all British Railways standard locomotives. Annexures B/11 and B/12 show the rocking firegrate of a B. R. Standard class 7 locomotive and the type of firebar used respectively.

On the New Zealand Government Railways the standard grate consists of loose firebars of conventional design supported on carriers. A drop grate is provided in the rear centre of the grate. Appendix B/14 shows a typical arrangement on the « K » class of locomotive. This type of grate has given good service and has proved suitable for a wide range of coals. Rocking grates and « Rosebud » grates have been tried out but gave no better results than obtained with the standard design.

Three types of grates have been used on the Norfolk and Western Railway in recent years; namely table grates, pinhole grates and firebar grates. This railway reports that it has been found that once an ash bed of 8 to 10 cm has been established the type of grate used is of little consequence in so far as draught, rate of combustion and fly ash are concerned.

Of the three types mentioned above, table grates are used predominantly on all open line locomotives. They have been arranged in six separate « shaking areas » to allow easier hand shaking.

The class SI switchers, which are hand fired, are equipped with firebar grates which are easier to shake by hand than either the table or pinhole grates.

Pinhole grates are in use on some of the classes A, J, and Y6 open line locomotives. It has been found that these grates afford improved air distribution resulting in some fuel economy at the beginning of a run before the ash bed has been established or during a run when the thickness of the ash bed on the various « shaking areas » is reduced unequally due to improper shaking. The most recent applications have employed pinhole grates in conjunction with table grates in order to obtain better air distribution over the grate as a whole. Annexure B/15 shows the grate arrangement on class J locomotives.

b) *Particulars of fuel and rates of combustion.*

Annexure A/11 gives particulars of the coals used by these three Railways.

On the British Railways coals tending to clinker are avoided if possible. All suitable coals in the United Kingdom are already in use, and it is not found that the use of rocking grates enables qualities of coal to be burned which are otherwise unsuitable.

A characteristic of New Zealand coal is the low ash content, usually about 6 % or less. Moreover the distances run by locomotives on regular rostered links are short, a few being from 100-180 miles (160 to 288 km) but for the most part being from 85 to 100 miles (136-160 km). On occasion the New Zealand Railways have used imported coal from various countries and found no difficulty in burning coals with ash content up to about 8 % with the particular type of grate in use, but Indian and South African coals with ash content of the order of 10-14.5 % gave

trouble due to the excessive accumulation of ash in the firebox.

The Norfolk and Western is now using a limited amount of low volatile bituminous coal on open line locomotives. This is a premium fuel as shown by the particulars given in Annexure A/11. It is more friable than the high volatile coal and there is more breakage due to the mechanical stoker screw. However, it has been found that even with stoker firing there is a saving in fuel because of the high fixed carbon and the low ash content.

Rates of combustion are given as follows, in kg per sq. m per h :

Railways	*Class*	*Maximum*	*Normal*	*Grate Area (sq.m)*	*Method of firing*
British Railways . .	7 4	590 590	 250-400	3.9 2.48	Hand Hand
Norfolk & Western. .	A Y6B J SI		415 395 390 54	11.33 9.87 10.00 4.181	Stoker Stoker Stoker Hand

In the case of the class SI locomotive of the Norfolk and Western Railway, which is used on switching service, the rate of combustion is given per « hour of service ».

c) *Grate proportions and air openings in grate and ashpan.*

The following data has been given in respect of the air openings through the grate and ashpan, expressed as a percentage of the grate area :

Railway	*Class of Locomotive*	*Through grate*	*Through ashpan*
British Railways	7 4	37 % 34.4	8.3 % 10.06
New Zealand Railways	K	35.8 %	14.4 %
Norfolk & Western Railway	A J Y6B SI	See notes below	10.4 % 10.0 10.3

Note. — *Norfolk and Western Railway.* Class SI, hand fired locomotives, have firebar grates with about 20 % free area through grates. This type of grate is not economically justifiable on open line locomotives.

Table grates, with about 38 % free opening through the grate, are used predominantly on all open line locomotives. These locomotives burn high volatile bituminous coal of which particulars are given in Annexure A/11.

Pinhole grates, used on some of the classes A, J and Y6 locomotives, have a free opening of about 25 % through the grates.

The British Railways use no special devices to facilitate correct distribution of air over the grate, but front and rear damper doors are provided in the ashpan. Overfire air is achieved by means of ports in the firedoor and a deflector plate inside the door directs the air downward over the fire. When more overfire air is required the firedoor may be left partially open and a hinged baffle plate is provided.

New Zealand Railways practice is to admit combustion air entirely through the grate. To reduce the admission of air over the fire while coal is being fired « Franklin » Butterfly firehole doors are fitted to the heavier classes of locomotives. No special devices are fitted to ashpans to correct distribution of air over the area of the firegrate.

No special devices on the ashpans of the Norfolk and Western locomotives and, in so far as overfire air is concerned, the class SI, only, have steam injectors to introduce this.

d) *Materials used for grates and their life.*

The British Railways use cast iron of ordinary quality for their grates. The life of the grates depends on the coal used and the nature of the duties but may be taken as 10-18 months.

The New Zealand Government Railways use ordinary grey cupola cast iron for fire grates.

Grates used by the Norfolk and Western are made of cast iron and have an average life of 10 to 15 years.

e) *Brick arches : Specification and life.*

British Railways use firebricks with an alumina content of approximately 30 % which have an overall average life of about 10 000 km.

The firebricks used by the New Zealand Government Railways are composed of Alumina (37 to 43 %) and Silica (51 to 57 %).

f) *Design and Dimensions of Brick Arches.*

On the British Railways the brick arches are formed of slab bricks and the carrier bars are protected from the fire by a leg of the firebrick. The length of the arch is designed in relation to an adequate passage for the gases leaving the fire and passing between the arch and the door plate and also the fire box crown. Where hard coals are used the arch is made as long as practicable, but may be shorter where high carbon coals are burnt.

Annexure B/13 shows the brick arch arrangement on British Railways class 4 locomotives. It will be noted that gaps in the arch are provided at the firebox tube plate.

Annexure B/16 shows the brick arch arrangement on the class Y6B locomotives of the Norfolk and Western Railway.

g) *Maximum grate area, and rate of firing, for hand firing.*

The British Railways indicate that under normal working conditions no difficulty is experienced in handfiring locomotives with grates up to 5 sq. m (approximately 54 sq. feet), and at a fuel rate of 1 400 kg per h (approximately 3 100 lb. per h).

The New Zealand Government Railways follow the criteria adopted at the Australian and New Zealand Railways Conference (1950) to determine when mechanical stokers are to be provided in future designs. These criteria are that if any one of the following factors is exceeded then stokers are to be provided :

1) grate area over 50 sq. feet (4.65 sq. m) ;

2) weight in driving wheels :

160 000 lb. (72.500 kg) for passenger locomotives;

175 000 lb. (79 500 kg) for freight locomotives:

3) cylinder horse power : over 2 000.

With the exception of the class SI switcher all Norfolk and Western locomotives are equipped with mechanical stokers. As this Railway puts it, when firing rates reach 4 500 to 6 350 kg per h (10 000 to 14 000 lbs. per h) provision of stokers is imperative. Consequently mechanical firing versus hand firing is not a question of fuel economy and no figures on this subject are available.

h) *Locomotives equipped with mechanical stokers.*

On the British Railways one locomotive only was equipped with a mechanical stoker but the stoker has now been removed, principally because the firing rates are such as to be within the capabilities of a fireman. It was found that coal consumption was approximately 25 % higher than with hand firing at normal rates of working when using the same quality of coal.

Experience with stoker equipped locomotives is limited on the New Zealand Government Railways to three Garratts which were placed in service in 1929. The heaviest hand fired locomotives are the « Ka » and « Kb », the latter being equipped with boosters.

Relevant particulars are as follows :

Type of locomotive	*Garratt*	« *Ka* »	« *Kb* »
Grate area	58.2 sq ft 5.4 sq.m	47.7 sq ft. 4.45 sq m.	47.7 sq ft. 4.45 sq m.
Adhesive weight . .	196 450 lb. 89 000 kg	125 440 lb. 57 000 kg	152 250 lb. (*) 69 000 kg (*)
Method of firing . . .	stoker	hand	hand
Service	Freight	Express and freight	Express and freight

(*) The adhesive weight of the class « Kb » includes the adhesion of the booster driven wheels.

The class K locomotives are considered to be approaching the limit that can be hand fired.

i) *Economic results.*

No economic balance sheets have been drawn up by the Railways now being dealt with.

j) *Oil firing of locomotives.*

Owing to a difficult situation in respect of the supply of coal at the end of World War II in England the former Great Western Railway commenced, in 1945, to convert some coal burning locomotives to oil burning. In 1946 a move was made to convert some 1 200 locomotives on British Railways to oil burning. By the middle of 1947, however, conditions had changed and the conversion of locomotives was suspended and, ultimately, the 93 locomotives which had been fitted up were re-converted to burn coal. At the present only one oil fired locomotive remains and is used on banking duties.

New Zealand went through similar difficulties in that there was an acute shortage of coal from 1943 onwards and 93 locomotives were converted to oil burning. From the middle of 1951 the coal situation in the country improved and a policy of reconverting 10 class « K » locomotives to burn coal was instituted. To the date of the report two conversions had been completed.

The Norfolk and Western Railway

makes no reference to the use of oil as a fuel in their locomotives.

On economic considerations British experience is that the use of oil fuel, whilst a practical proposition, is less economical than the use of coal from the point of view of capital outlay, maintenance and fuel economy. Moreover the cost of oil fuel is more than the cost of coal on a heat unit basis.

The following figures of coal and oil fuel consumption are given :

Railway System	*Class of Locomotive*	*Oil kg/kilometre*	*Equivalent coal kg/kilometre*	*Actual coal kg/kilometre*
Western Region	«Castle»	12.7	18.7	15.3
	«Hall»	14.0	20.7	16.7
	«28XX»	18.1	26.7	19.3
London Midland Region	5 «mixed traffic»	8.65 — 20.3	12.7 — 29.7	18.4
	4F	9.45 — 13.5	13.9 — 19.9	19.4
	7F	16.2	23.8	22.7
	8F	18.9	27.8	22.7
Eastern & North Eastern region		16.2	23.8	21.6

The New Zealand Government Railways record similar experiences and give the following figures showing, for a « K » class locomotive, the costs in pence per engine mile for native coals, imported oil fuel and imported coal.

Year	*Sub-bituminous coal (native)*	*Bituminous coal (native)*	*Oil Fuel (imported)*	*Bituminous coal (imported)*
1947	16.0	24.6	45.8	96.6
1949	15.9	29.0	56.6	67.6
1951	30.0	43.5	63.4	58.0
1953	34.3	52.2	93.4	130.5 (1952)

SUMMARY.

Different types of grates are favoured by each of the Railways referred to in the Addendum and there is not a great degree of uniformity in grate proportions, which is understandable in view of the different characteristics of the coal used.

An interesting deviation from the summary given in the main report is the information given by the Norfolk and

Western Railway that it obtains an average life of 10 to 15 years for cast iron grates as compared with 1 to 4 years reported by other railways.

With regard to the use of mechanical stokers, all locomotives on the Norfolk and Western Railway, except the class SI switcher, are so equipped. This is imperative in view of the large quantities of coal consumed by the locomotives and it is not a question of burning fuel efficiently.

C. SUPERHEATING.

a) *Temperatures obtained and trend in temperatures.*

The British Railways obtain steam temperatures from 250° C to 375° C (482° F to 707° F) with boiler pressures ranging from 14.0 to 19.7 kg per sq. cm (200 to 280 lb. per sq. inch). It is considered desirable to obtain a working range 375° C to 400° C (707° F to 752° F) the higher figure being regarded as a maximum on account of lubrication.

On the New Zealand Government Railways tests on the class « K » locomotive have given a steam temperature of 321° C (610° F) at a boiler pressure of 14.0 kg per sq. cm (200 lb. per sq. inch). Owing to the fact that the boiler of the class « K » locomotive is built right up to the maximum dimensions permitted by the loading gauge, it is not considered possible to achieve the higher steam temperatures attained in other countries.

The Norfolk and Western Railways have recorded steam temperatures ranging from 329° C to 368° C (624° F to 694° F) with an average of 341° C (646° F) at a boiler pressure of 21.10 kg per sq. cm (300 lb. per sq. inch). This temperature range is considered to be near the maximum desirable because of adverse effects of higher temperatures on piston packing and lubrication.

b) *Superheater arrangement.*

The British Railways and the New Zealand Government Railways use only « A » type elements, with four passes in the flue tube, while 57 out of 448 locomotives on the Norfolk and Western Railway are fitted with type « E » elements, the balance being fitted with the type « A ».

With regard to the distance between the return bends and the firebox tube plate British Railways use a dimension of 500 mm (19.7 inches) on their standard locomotives; 300 mm (11.8 inches) resulted in burnt return bends. The New Zealand Railways use 457 mm (18 inches) on coal burning locomotives and 1 220 mm (48 inches) when oil fuel is used. On the Norfolk and Western Railway the distance varies from 559 to 625 mm (22 to 25 inches).

No unusual types of superheater headers are reported upon except that in some cases multiple valve regulators in the header are used. The use of spherical seatings for the elements is common to the three railways.

c) *Drop in pressure from boiler to valves.*

The following figures are given :

British Railways :

0.63-0.88 kg per cm (9.0-12.5 lb. per sq. inch) at maximum output;

0.35-0.6 kg per sq. cm (5.0-8.5 lb. per sq. inch) at 2/3 output.

Norfolk and Western Railway : 1.05-1.4 kg per sq. cm (15.0-20 lb. per sq. inch).

d) *Special devices to prevent carry over of water.*

Only the British Railways use a centrifugal steam drier. This fitting is used on locomotives equipped with multiple valve regulators and is shown on Annexure C/4.

Class « J » and « K » locomotives of the New Zealand Railways were previously fitted with steam driers, but they deteriorated in service and were taken off. Washplates are now provided between the dome and firebox.

e) *Maintenance of superheater elements.*

The British Railways report that the majority of element changes are due to burst or leakage in the vicinity of the return bends, leakage at the header joints being a lesser cause of failure. Element changes may amount to a maximum of about 9 per locomotive per annum.

All elements are removed and tested when locomotives undergo both intermediate and general repairs. Test procedure covers the following:

1) examination for pitting, burning and thinness and replaced when necessary. In some cases replacement is based on a laid down figure of between 10 % and 15 % loss of weight;

2) hydraulic test to 24.5 to 28 kg per sq. cm (350 to 400 lb. per sq. inch) and hammer tested;

3) followed by examination for distortion and general condition;

4) repair may consist of renewal of return bends, new down comer pipes (infrequent), straightening, and usually fitting new clips. Ball joint ends are re-cut and ground to smooth finish.

5) before refitting to boiler elements are given a further pressure test and the header seats are re-ground with a portable machine.

The New Zealand Railways refer to trouble experienced with header bolts stretching due to high temperature when the « K » class locomotives were converted to burn oil fuel. The adoption of heat resisting steel (18 % chromium, 8 % nickel) has almost eliminated trouble in this direction.

f) *Economic balance sheet and conclusions.*

The limit to increasing appreciably the degree of superheat now obtained is set by the fact that ultimately considerations of fuel economy would be outweighed by maintenance problems of cylinders and valves.

The upper limit of the temperature which can be used with advantage has been given as 375° C (707° F) by British Railways, 321° C (610° F) by the New Zealand Railways where physical dimensions of the boiler play a part, and 368° C (694° F) in the case of the Norfolk and Western Railway.

The British Railways give the following ratios as producing good results:

Total evaporative surface to grate area .	50 to 60.
A/S as near 1/400 as possible, but may vary from	1/350 to 1.450.
Free area through tubes to grate area . .	14 % to 17 %.
Free area through flue tubes to total free area	65 % is about the practical limit.

The Norfolk and Western give the following data in respect of the relation between superheating surface and total heating surface for certain of their locomotives.

Class of Loco.	*Type of superheater*	*Superheating surface Sq.m.*	*Total heating surface Sq.m.*	*Superheat surface as % of total heating surface*
A	Elesco «E»	251.1	868.9	28.90 %
J	Elesco «E»	202.2	691.9	29.23 %
Y6B	Elesco «A»	137.3	590.1	23.26 %
SIa	Elesco «A»	59.2	297.9	19.86 %

g) *Lubrication.*

Annexure C/3 gives characteristics of the cylinder lubricating oils used by the three Railways dealt with here.

British Railways and the Norfolk and Western Railway use mechanical lubricators. Up to the introduction of the « K » type locomotives the New Zealand Railways used hydrostatic lubricators. Thereafter mechanical lubricators have been fitted.

The British Railways give the consumption of oil as 0.35 to 0.6 g per feed with a two cylinder locomotive having a 12 feed lubricator. The consumption per kilometre is thus of the order of 6 g.

The New Zealand Railways give the following comparative data showing piston and valve ring life for a number of classes « K » and « Ka » locomotives, with hydrostatic and mechanical lubricators:

	Hydrostatic lubricator.	*Mechanical lubricator.*
Piston rings	23 500 miles (37 600 km)	34 000 miles (54 400 km).
Valve rings	51 000 miles (81 600 km)	50 500 miles (80 800 km).

As a result of the above experience the heavy classes « J » and « K » locomotives are to be equipped with mechanical lubricators.

The Norfolk and Western Railway gives a consumption of 1 litre per 28 km for passenger, light freight and switching service, and 1 litre per 12.4 km for heavy freight service.

h) *Characteristics of rings, valves and pistons.*

i) *Rings.*

British Railways practice is to use Ramsbottom type rings of cast iron, cylinder quality. Drums are sand cast of a size to make a number of rings which are peened. Piston and valve rings are changed at standard examinations which are carried out at 48 000 to 58 000 km (30 000 to 36 250 miles), although in the case of certain classes of locomotives piston rings are changed at intervals of 32 000 to 39 000 km (20 000 to 23 375 miles).

The standard arrangements for pistons in the New Zealand Railways is to use two rings 1/2″ by 1/2″ in cross section (12.7 mm by 12.7 mm). Segmental rings of a proprietary make have been tried but when these were in short supply, reversion to the two rings showed no loss in efficiency. Piston valves have two rings in each head, with a bull ring.

A typical analysis of the cast iron used by the New Zealand Railways for piston and valve rings is as follows:

Carbon	3.2-3.5 %.
Silicon	1.8-2.0 %.
Manganese	0.6-0.8 %.
Phosphorous . . .	0.4 %.
Sulphur	0.1 %.
Modulus of elasticity	10 to 11 $\times$ 10^6 lb. per sq. inch (.703 to .773 $\times$ 10^6 kg per sq. cm).

Under g) *Lubrication,* above, certain figures are given showing ring life on these Railways. It is also reported that when the first imported class « J » locomotives went into service piston ring life of 75 000 miles (120 000 km) was not uncommon. Investigation showed that these rings had a modulus of elasticity of only 7 $\times$ 10^6 lbs. per sq. inch (.492 kg per sq. cm) and that a considerable percentage of the carbon was present as graphite.

ii) *Valves.*

British Railways describe two types of valve heads used with their piston valves. The first, of conventional design, is made of cylinder quality cast iron and is fitted with six narrow rings from 1/4″ to 3/8″ wide (6.35 to 9.52 mm), depending on

steam chest diameter, by 5/16″ deep (7.94 mm). The valve heads normally run for 100 000 to 160 000 km (62 500 to 100 000 miles) and may then be suitable for turning down to suit a smaller steam chest liner.

The second is the Swindon type semi-plug valve used on Great Western Region locomotives only. This type is shown on Annexure C/5. The heads and rings are of cylinder quality cast iron and the spindles and spindle sleeves to B. S. 24/9C and B. S. 24/9A respectively. The rings have an average life of 32 000 km (20 000 miles) and the heads and spindles give over 160 000 km (100 000 miles).

The New Zealand Railways use, as standard, the hollow spool piston valve of the Pennsylvania pattern which is preferred because it is lighter than other types.

iii) *Pistons.*

Two types of pistons heads are described by British Railways the first being a box type casting of cylinder mixture cast iron or, on B. R. standard classes 6 and 7 locomotives, of steel. The head is fitted with two rings 5/16″ to 7/16″ wide (7.94 to 11.11 mm) by 9/16″ (14.29 mm) deep and a spring loaded bronze carrier 7/8″ (22.22 mm) wide with a 60° arc. These piston heads normally run 90 000 to 160 000 km (56 250 to 100 000 miles) and in some cases can be skimmed down for further use.

The second type is forged of steel to specification B. R. S. 104, Grade 5. The head is made by drop stamping and has a short portion of the piston rod formed integrally. The unmachined rod forging is then flash butt welded to this projection and the whole then machined to final dimensions. The life is given as 8 to 9 years or 800 000 km (500 000 miles).

On the New Zealand Railways the pistons are of conventional design and are usually made of unalloyed cast iron complying with B. S. S. 786, Grade 2 and having a tensible strength of 40 000 to 43 000 lbs. per sq. inch (2 810 to 3 020 kg per sq. cm). For special applications castings to B. S. S. 786, Grade 4 with 1.6 to 1.9 % nickel and 0.7 to 0.8 % molybdenum are used, having a tensile strength of 50 000 to 55 000 lb. per sq. inch (3 620 to 3 870 kg per sq. cm).

On 213 of the modern locomotives of the Norfolk and Western Railway pistons with a cast steel centre, onto which are rivetted cast iron drag rings, are used. The packing is a non-lip type consisting of segments of bronze and cast iron. The drag ring supports the weight of the piston and when worn is replaced. The class J locomotives and five of the class A locomotives are fitted with light weight cast steel pistons, with lip type segmental packing which carries the weight of the piston. On the low pressure pistons of Mallet locomotives a one piece cast iron ring is used. The ring is cut at one place so that it can be slipped on to the drag ring.

iv) *Piston and piston valve rod packing.*

On the British Railways cast iron piston rod packing is generally used. In so far as valve spindles are concerned since their locomotives have inside admission no packing is fitted but the spindles run in gunmetal bushes lined with whitemetal.

The table on the following page gives particulars of three types of piston rod packing.

Annexure C/6 shows the « UK » type of packing.

The standard piston rod packing used by the New Zealand Government Railways, on all classes of locomotives, except « K », is of the « King » type. The gland itself is whitemetal with the following composition :

Lead	88 %.
Antimony	6 %.
Tin	6 %.
Melting point	240° C (464° F).

Tke « K » class locomotives have « Britemp », segmental packing rings. This

Type	*Cast Iron*	*«U.K.»*	*«Castle»*
Material	Cast iron, cylinder quality	High phosphor cast iron .	Graphited asbestos rope to WR specification G.S.85 List 38.
Composition . . .	Total Carbon 3.0-3.3 % Combined Carbon 0.6-0.8 % Silicon 1.1-1.6 % Manganese 0.6-0.8 % Sulphur Max. 0.12 % Phosphorous 0.7-1.0 %	Carbon 3.2-3.3 % Silicon 2.0-2.2 % Manganese .25-.35 % Sulphur .10-.15 % Phosphorous 1.0-1.2 %	
Melting temperature	950° C - 1 200° C (1 742° F - 2 192° F)	950° C - 1 200° C (1 742° F - 2 192° F)	
Temperature of contact steam .	400° C (752° F) Max.	400° C (752° F) Max.	Approx. 370° C (698° F)
Piston rod material	Steel to BRS. 103 Grade 6F	Steel to BRS. 103 Grade 5F or 6F	Steel to BS. 24/8 (class C). Hardened and tempered. Equivalent to BRS. 103/5F.
Replacement of packing	When worn to extent that gaps are closed or when rings break.	Can be adjusted to serve between normal shop repairs, say up to 150 000 km (93 750 miles). May then be fitted to larger rods for 2 more periods.	Has to be renewed at approximately 8 000 km (5 000 miles.)
Life	Variable. Average about 60 000 km (37 500 miles)	450 000 km (281 250 miles)	8 000 km (5 000 miles).
Lubrication . . .	Cylinder oil mechanically fed to stuffing box plus engine oil fed to swab box by means of trimming.	By lubricator to steam pipes or direct to cylinders, also by swab to piston rod.	Swab in casing round piston rod, fed from oilbox with worsted trimming.
Influence of superheat temperature.	Used on wide range of locomotives. Does not appear to be unduly affected by high temperatures.	As for «Cast Iron» type.	Used on Western Region where highly superheated steam not generally used.
Results in Service	Reasonably satisfactory if material & lubrification correct. Piston rod wear slight. Steam leakage unless packing beds down correctly. Castings must have graphite in flakes. No annealing.	Very good results on the Southern Region. Trials being extended.	Good results on the Western Region. Less satisfactory elsewhere.

design gives satisfactory service but shows no clear cut advantage over the « King » type and was not perpetuated when the « J » class locomotive was designed.

In respect of valve rod packing, the heavier classes of locomotives are fitted with « King » type while the older locomotives are fitted with plain bushes with oil grooves. All locomotives have inside admission.

Piston rods of the New Zealand Railways locomotives are of steel to B. S. S. 24, Part 4, Specification 9.

SUMMARY.

1) The optimum superheat temperatures aimed at by the Railways dealt with in this Addendum are within the range aimed at by the Railways dealt with in the main Report.

2) The Norfolk and Western Railway is the only one which has used the « E » type element. This type is used on 57 of their 446 superheated locomotives.

3) Only the British Railways report the use of centrifugal steam driers. This fitting is used on locomotives equipped with multiple valve regulators.

4) British Railways and the New Zealand Railways use cast iron valve and piston rings, while the Norfolk and Western Railway have a number of locomotives fitted with bronze and cast iron segmental rings.

5) As previously reported there is little uniformity in the types of piston and valve rod packing, cast iron rings predominating. British Railways use graphited asbestos rope as a piston packing in some cases where the superheat temperature is not high.

D. PREHEATING OF THE FEED WATER.

The British Railways report that no recent experiments with feed water heaters have been carried out. At present two locomotives are equipped with Dabeg feed water heaters while approximately 5 700 out of a total of approximately 15 700 locomotives, excluding shunting locomotives are equipped with exhaust steam injectors.

The following figures are given relating to locomotive and boiler performance with exhaust steam injectors.

Influence on superheat	General tendency for the temperature to be a little lower when an exhaust steam injector is used.
Influence on steam pressure at exhaust .	8 1/2 % to 9 1/2 % decrease.
Influence on draught	8 1/2 % to 9 1/2 % decrease.
Influence on power of the locomotive . .	For same cold feed rate power is increased by 5.6 % up to limit of exhaust steam injector. Decreases above this point.

British Railways point out that exhaust steam injectors require more maintenance, although no comparative figures are available, but that when used on locomotives working under continuous reasonably heavy conditions a valuable coal and water saving results which outweighs the additional maintenance and first cost involved.

With regard to the economic balance sheet it is pointed out that the maximum evaporative rates for a given boiler, with or without an exhaust steam injector, are such that the cold feed rates are the same. As the rate of steam returned to the boiler from the cylinders, by an exhaust steam injector, at this rate of working represents 5.6 % of the steam rate to the cylinders the increased ouput of the boilers is of the same order. Under conditions of analytical testing the saving of water is 5.6 %. The saving of coal varies with the rate of

	Maximum Power	*2/3 Maximum Power*
Temperature of steam on leaving low pressure cylinders (Max. admission temperatures 370° C - 400° C (698° F - 752° F)	160° C (320° F)	120 C (248° F)
Percentage of exhaust steam used in exhaust injector	5.6 % up to limit of exhaust steam injector. Decrease above this point.	5.6 %
Increase in temperature of water between entering and leaving exhaust injector	38° C (100° F)	55° C (131° F)
Consumption of steam from boiler i.e. supplementary steam	Approx. 50 % of the exhaust steam increasing above limit of exhaust injector .	Approx. 50 %
Temperature of combustion gas in smokebox	400° C (752° F)	360° C (680° F)

working but at a rate equal to 2/3 of the maximum the coal saving is of the order of 7.3 %.

Tests on passenger trains showed a considerable difference in economy obtained with an express train as compared with a stopping train :

	Express train.	*Stopping train.*
Water saving . . .	7.8 %	3.3 %
Coal saving . . .	12.7 %	2.3 %

As a means of preheating boiler feed water the British Railways prefer the exhaust steam injector as being a relatively inexpensive fitting which when reasonably well maintained gives good reliability and savings of substantially the same order as the older type of preheater with far less initial and maintenance costs.

It is the intention to try out Franco-Crosti preheaters, for comparative purposes on 10 heavy freight locomotives.

After successful preliminary trials the New Zealand Railways equipped a number of locomotives of the « K » class with feed water heaters. In comparative tests against similar locomotives with exhaust steam injectors those equipped with feed water heaters showed a 6 1/2 % saving in fuel.

However in prolonged service it was found that both the pumps and the piping of the feed water equipment required a lot of attention and it was found that the additional maintenance costs more than offset the fuel economies. Consequently in 1945, it was decided to replace feed water heaters by exhaust steam injectors as locomotives went through shops for overhaul.

The present position that of the total stock of 524 main line locomotives, 242 are equipped with one exhaust steam injector and one live steam injector, the balance being equipped with two live steam injectors.

The New Zealand Railways also find that for shunting locomotives and for locomotives working suburban and other trains making frequent stops the exhaust steam injector is not warranted. For locomotives working passenger or goods trains under normal running conditions, however, a fuel economy of the order of 7 % as compared

with live steam injectors has been realised. Maintenance is somewhat heavier than for live steam injectors, but the fuel and water economy more than compensates for this.

The experience of the Norfolk and Western Railway, however, differs from that of the two Railway Administrations referred to above. This Railway reports that comparative tests, made in 1927, showed that the exhaust steam heater-pump combination was superior to the exhaust steam injector in that a larger recovery of heat was obtained, operation was more simple and dependable, and maintenance costs were lower.

The present position is that of 448 locomotives in service 343 are equipped with Worthington open-type feedwater heaters. These 343 locomotives include all of the modern locomotives with the exception of the class SI and SIa switches.

The following table is given to show the characteristics of the type SA heater during five test runs of the class Y6B locomotive, as later referred to in Section M.

	Average of 5 runs
Boiler pressure	20.82 kg per sq cm (296 lb per sq in)
Steam chest pressure	19.55 kg per sq cm (278 lb per sq. in)
Receiver pressure	6.54 kg per sq cm (93 lb per sq in)
Temperature of exhaust steam to the feed water heater	127° C (261° F)
Temperature of water entering the feed water heater	23 °C (73° F)
Temperature of water leaving the feedwater heater	121° C (250° F)
Percentage of exhaust steam used by the heater	15.04 %

The Norfolk and Western Railway list the following gains which they have experienced through the use of feed water heaters. The quality of water supplied to the boiler has been greatly improved resulting in the extension in the period between washing out boilers to the maximum of 30 days allowed under government regulations. The greater period between washouts has resulted in longer life for boiler parts and in increased locomotive availability. The boiler efficiency is increased because of less carbon loss due to the lower rate of combustion. The cylinder performance is improved slightly by some reduction in back pressure as less draught is required for the lower demand on the boiler for a given horsepower.

SUMMARY.

Both British Railways and the New Zealand Railways have a large proportion of their locomotives equipped with exhaust steam injectors and find the resulting economies with this equipment more than compensate for the somewhat heavier maintenance as compared with live steam injectors.

The New Zealand Railways have found that the heavy maintenance of pump type feed water heaters more than offsets the fuel economy and has abandoned this equipment where it had been fitted.

In respect of the pump type feed water heater the Norfolk and Western Railway differs from all other Railways who reported on this appliance. This Railway is emphatic that the economies gained by means of feedwater heaters outweight all other considerations. Of 448 locomotives in service 343 are equipped with feedwater heaters.

E. TREATMENT OF THE WATER.

The New Zealand Railways state that, generally speaking, the quality of the water used is sufficiently good to enable using it without treatment. The hardness of the water is predominantly temporary. The supply at Invercargill, which is drawn from artesian wells, requires treatment, however, and this has been carried out since 1941.

Summary of individual replies.

1. *Physical treatment of water inside boiler.*

No replies in the affirmative.

2. *Chemical treatment of water inside boiler.*

The three Railways dealt with here use this form of treatment.

2 *a*) to 2 *c*). *Method of introducing the reagent into tender.*

British Railways.

a) Hand dosing in the tender in some cases;

b) Special devices used include the T. L. A. method using a hydrostatic doser in the tender, and a small scale use of tube feeders containing I. C. I. briquettes;

c) Special devices preferred to hand dosing.

Norfolk and Western Railway.

The « Automatic Wayside Treatment » is used. In this process the chemical agents are pumped into the water supply as it goes into the tender.

3. *Introduction of chemicals direct into the boiler.*

This method is not used.

4. *Chemicals used for treating water inside boiler.*

British Railways.

T. L. A. chemicals and I. C. I. briquettes.

New Zealand Railways.

The dosing consists of 28 lb. soda ash, 16 lb. caustic soda, and 2 gallons anti-priming compound per 100 000 gallons of water. The anti-priming compound consists of a 6 % solution of chloresterol in acetone.

Norfolk and Western Railway.

National Aluminate Corporation's Nalco ## 8 compound is added to the feedwater in the proportion of 0.1 to 0.3 kg per 10 m³ of water (10 to 30 lbs. per 100 000 gallons), and an anti-foaming agent, Nalco « N », is applied in the proportion of 0.1 kg per 10 m³ of water (10 lbs. per 100 000 gallons). The quantity of soda-ash used with the Nalco « N » and ## 8 compound is based on the permanent hardness, or sulphate content of the water. In a few treatment plants, where it is desirable to neutralise the permanent hardness and keep the alkalinity below a given point, sodium bicarbonate is used instead of soda-ash.

5. *Regulation of treatment and analysis of boiler water.*

British Railways.

Regulation of treatment comes under the control of the Mechanical and Electrical Engineer's Headquarters Water Treatment Section. Local Water Treatment Controllers at the depots make daily tests of samples of boiler water taken from locomotives to arrive at the hardness, caustic and phenolphthalein alkalinities and total dissolved solids. These are recorded in a statement and sent in after each washout period. Local controllers have authority to add additional dosage by hand, temporarily, should results not be up to the required standard.

New Zealand Railways.

At Invercargill, the aim of the treatment is to give the water a pH' value of 8.6, and slight changes to the soda ash content are made occasionally to hold the alkalinity up to the figure.

Norfolk and Western Railway.

At each of the large watering points daily tests are carried out and, where necessary, adjustments to the treatment are made. The daily tests are recorded and frequently checked. Weekly, samples of the untreated and treated water are sent to the chemical laboratory for routine analysis. This analysis includes soap hardness, methyl red alkalinity and phenol alkalinity. Equipment is also available at certain points to determine the dissolved solids in locomotive boiler water in the event of a locomotive being reported as having had water trouble.

6. *Central and local organisation for controlling water treatment.*

British Railways.

The Headquarters organisation of the Regional Water Treatment Section of the Mechanical and Electrical Engineer's Department consists of a Water Treatment Assistant, assisted by a Water Treatment Chemist and Mechanical Assistant and Headquarters Water Treatment Inspector. Local arrangements at the depots involve the employment of a Water Treatment Controller under the direction of the Mechanical and Electrical Engineer's Department Water Treatment Section and assisted by labourers drawn from the Motive Power Staff for applying treatment.

New Zealand Railways.

The water treatment plant at Invercargill is under the control of the District Mechanical Engineer at Dunedin.

Norfolk and Western Railway.

Installation of water treatment equipment and prescribing the treatment of water is directed by the Chemical Laboratory through its Water Service Supervisors. These supervisors have assigned territories in which they check the various treating plants and regulate the treatment. In addition, at each of the larger watering points a man, who has received the necessary instruction, makes daily tests and carries out any necessary adjustments to the treatment.

7. *Method of blowing down — hand operated valves or automatic continuous device.*

British Railways.

Use is made of both hand-operated and footplate control steam-operated intermittent blowdown valves. Such devices are preferred as being more effective in sludge removal (and reduction in total dissolved solids) than an automatic continuous device linked up with the production of steam.

The amount of blowdown is approximately 710 litres for a run during which 20 000 litres of water are evaporated.

The average total hardness of the water is approximately 12° (17° metric) of which 3° (4.3° metric) is permanent hardness.

New Zealand Railways.

Locomotives are equipped with manually operated blowdown cocks. These are not used to any large extent because of the noise and because, once opened, it cannot be certain that they can be shut again completely.

The last five of a recent order of class Ja locomotives are equipped with T. I. A. blowdown equipment. It is laid down that a 30 sec. blowdown shall be given every 30 min. This equipment has been in operation for only six months, at the time of reporting, so that no firm conclusions have been formed.

Norfolk and Western Railway.

All modern open line locomotives are equipped with an automatic blowdown device which operates when the feed water pump is used. Over and above this manual blowdown is used and each division is instructed as to the amount of manual blowdown normally necessary and each terminal has instructions for proper terminal blowdown.

8. *Periods between washouts before and after treatment.*

British Railways.

Periods between washing out have been increased up to 56 days from the average previous intervals of 11 days.

New Zealand Railways.

The five class Ja locomotives with T.I.A. equipment are on a 14 day washout period compared with 7 days for other locomotives of the same depot.

Norfolk and Western Railways.

The period now between washouts is 30 days, the maximum allowable under government regulations.

9. *Results obtained with chemical treatment.*

British Railways.

The indications are that good results are being obtained. The period between general overhauls, of locomotives using treated water, has not been finally established. Certain locomotives have completed 320 000 km (200 000 miles) and are still in service.

Shed maintenance has been considerably reduced between periodic repairs where comprehensive treatment has been applied.

Norfolk and Western Railway.

Good results are reported. Corrosion inside the boiler and boiler fittings is no longer a problem.

10. *Difficulties experienced as regards internal treatment* a) *to* c).

British Railways.

The phenomenon of ebullition (priming) has been reduced to a minimum by the use of tensio-active material for use with T. I. A. compound and by making use of a compounded briquette in the case of the I. C. I. product which contains an anti-foam material combined with the briquette.

No undue trouble is experienced in respect of scale in the injectors or in the pipes feeding water into the boiler.

Norfolk and Western Railway.

The only trouble reported is the occasional foaming but this is put down to failure to follow blowdown instructions, use of water from untreated supplies or periods of extremely dry weather causing the chlorides in the water to become excessive.

11. *Formation of scale in smoke tubes where water enters boiler.*

British Railways.

This is in evidence but not to a marked degree.

12. *Measures adopted to combat formation of scale in smoke tubes.*

British Railways.

a) *Fitting of deflectors to divert jet.*

No deflectors have been fitted specially in the case of locomotives to which T. I. A. water treatment is applied but it is the standard practice on the British standard locomotives to fit deflectors under the top feed delivery inlets so as to deflect the water round the bank of tubes;

b) *Use of stabilising substances to retard precipitation.*

Chestnut tannin is present in the T. I. A. compound and other suitable forms of tannin and phosphates are present in the I. C. I. briquettes.

13. *Conclusions reached on 12* a) *and 12* b).

British Railways.

With the waters used on the Southern Region, where T. I. A. water treatment is in operation, no undue difficulties have been experienced, and the deposits which occur in the area referred to are, generally, of a soft nature.

14. *Has the above-mentioned phenomenon been noticed with all types of water?*

No replies.

15. *Limit of salinity which should not be exceeded in boiler water.*

British Railways.

This should not exceed 8.5 to 10 g/l with the use of anti-foam.

16. a) *Corrosion in water level glasses.*

British Railways.

Not serious where T. I. A. or I. C. I. briquette treatment is in operation. With lime-soda water treatment plant, however, considerable corrosion has occurred;

b) *Corrosion of bronze valves.*

British Railways.

None observed.

Norfolk and Western Railway.

With the water treatment now in operation corrosion of boiler fittings is no longer a problem.

c) *Corrosion of lead joints in clack valves.*

British Railways.

This jointing is not used.

d) *Corrosion in fusible plugs.*

British Railways.

Not appreciable.

17. *Metal used for fusible plugs.*

British Railways.

Pure lead is used for the conventional type of fusible plug.

The pellet, or drop, type of plug in which a gun metal pellet is sweated into a recess in the plug with pure lead is also used.

Norfolk and Western Railway.

Fusible plugs are not used; all locomotives are equipped with low-water alarms.

18. *Steps taken to prevent corrosion of fusible plugs.*

British Railways.

In the case of the conventional type of lead filled plugs the surface of the lead exposed to the boiler water is copper plated.

19. *Economic balance sheet.*

British Railways.

This Railway Administration considers that the method of water treatment most suitable for locomotives appears to be a combination of lime-soda bulk softened water at points of large consumption and high degree of hardness and a form of internal treatment by means of a special device carried on locomotive tenders. It is recognised that success in water treatment is dependent on adequate control being exercised, by all at all times.

SUMMARY.

The reporting Railways have gained from treatment of boiler waters, the New Zealand Railways to a lesser extent than the others as, generally, the waters used are of good quality.

As in the case of the railways referred to in the main report methods of treatment vary because of different water conditions but it is again the concensus of opinion that good control of treatment is essential for success.

F. LAGGING OF BOILERS.

British Railways list four types of material used for lagging boilers and offer the following comments on the experience with each.

i) *Plastic magnesia.* — Made up into a « pug » and moulded on the boiler, which is then steamed for 8 1/2 h to cause the material to set.

Boiler leakage cuts through the material but this can be readily replaced following repairs.

Each application has to be removed at boiler repairs, but the material can be used over and over again.

ii) *Block type asbestos.* — Blocks cut to

shape and wired on to the boiler. Some types are covered with asbestos cloth.

Leaks cut through unclothed blocks. Clothed blocks give better resistance.

Blocks normally last 3 years, but portions can be refitted. The rest of the material is used as « pug » for moulding on other parts of the locomotive.

iii) *Asbestos mattresses.* — Two layers of asbestos cloth with asbestos fibre between. Made up into suitable sizes, approximately 1″ (25 mm) thick, provided with eyelets and wired on to the boiler.

Stand up reasonably well to leakages, and after removal to effect repairs to boiler may be replaced.

The life is approximately 15 years.

iv) *Fibreglass mattresses.* — Two layers of wire mesh with fibreglass between them. Exterior surfaces sprayed with plastic substance. Made up into mattresses of suitable size and about 1″ (25 mm) thick. Wired onto boiler as with asbestos mattresses.

Indication is that leakages cause corrosion of wire mesh and consequent disintegration of the fibreglass.

Insufficient experience with this material has been had to indicate the total life.

British Railways report that the insulating properties of the four materials are roughly similar.

Plastic magnesia is given as by far the cheapest form of insulating material but it has the disadvantage of the time taken to apply it. The block type asbestos is cheap and quite effective, but asbestos and fibreglass mattresses, although more expensive, are considered more convenient for applying to the boiler. There is little price difference between asbestos and fibreglass, but the latter is lighter and is thus important where weight is a consideration. Lightweight asbestos mattresses are now available, but information is not yet available as to their life. In general it appears that the life of asbestos mattresses will be greater than fibreglass.

The New Zealand Railways have standardised on corrugated asbestos sheet built in layers from 1″ to 2 1/2″ (25 to 62.5 mm) thick as required. Sheets are roughly 2 feet × 3 feet (610 × 914 cm) and are supplied flat or curved to suit boiler radius. The preference for corrugated asbestos sheeting, over magnesia blocks, which have been used, lies chiefly that it is light and easy to handle. Asbestos meal (pug) is used for odd corners.

The lagging is secured by wire to the boiler, and the steel wrapping sheets give the lagging considerable support.

It is the experience of the New Zealand Railways that ingress of rain water has a greater bearing on deterioration of the lagging than boiler leaks. For this reason particular attention is paid to the tightness of crinoline bands.

Corrugated asbestos sheets last up to 12 years, the prescribed period between external boiler examinations, provided it is not necessary to remove considerable portions of the lagging for interim boiler repairs.

The Norfolk and Western Railway use 85 % magnesia blocks for lagging boiler barrels. These are supplied 15.3 cm by 101.6 cm (6 inches by 40 inches) by 3.81 cm and 6.35 cm (1 1/2 inches and 2 1/2 inches) in thickness. The blocks are held in place by wires running through them and encircling the barrel and by the boiler jacket. The lagging applied to the firebox consists of ground asbestos in the form of mortar, held in place by the jacket.

These materials do not withstand steam or water leaks and their life depends on when they have to be removed from the boiler in order to carry out boiler maintenance.

SUMMARY.

There is no uniformity in respect of the type of lagging material used by the three Railways dealt with in this Addendum — asbestos mattresses, corrugated asbestos sheets, and magnesia blocks each

type having its protagonist. British Railways are trying fibreglass mattresses.

G. EXHAUST.

British Railways prefer the plain single circular blast pipe exhausting through a single circular chimney as being the most simple type and, if suitably proportioned, giving satisfactory steaming characteristics. Of a total of 18 859 steam locomotives, as at 31 December 1952, approximately 18 200 are equipped with this arrangement.

Figures for the maximum combustion rate and rate of vaporisation for two classes of locomotives with this arrangement are as follows :

	B.R. Standard Class 7	*B.R. Standard Class 4*
Max. combustion rate :		
kg. per sq.m. per hour	590	590
lb. per sq. ft per hour	121	121
Max. rate of vaporisation :		
kg per hour	13 600	8 900
lb. per hour	30 000	19 600

Annexures G/12 and G/13 show characteristic curves for the exhaust and the formulae on which the designs of the exhaust were based, respectively.

It is recorded that the self cleaning equipment in the smokebox practically eliminates all emission of sparks from the chimney.

The following information is given regarding other blast pipe arrangements tried out by British Railways.

i) Double blast pipe, i.e. 2 circular orifices exhausting from separate circular chimneys (247 locomotives equipped).

It is reported that in general this arrangement shows no advantage over the standard arrangement at moderate rates of working, but at high outputs improved steaming is generally obtained.

ii) Annular blast pipe (Adams « Vortex » type), with which 151 locomotives are fitted.

This type was used in an endeavour to improve steaming on locomotives where this was not very satisfactory. Some small improvement resulted, but the annulus must be cleaned regularly if the improvement is to be maintained.

iii) Multiple jet blast pipe (Lemaître type), used on 241 locomotives.

This type has a very powerful ejector action and has been applied to certain 2, 3 and 4 cylinder locomotives which previously did not steam well and which are now considerably improved.

The experience of the British Railways is that the simple circular blast pipe and chimney gives a satisfactory exhaust arrangement in most locomotives and is to be preferred. In the case of higher power 3 and 4 cylinder locomotives, where the loading gauge restricts the length of the chimney, there may be a definite advantage in using the double blast pipe and chimney. This arrangement also reduces back pressure. The multiple jet blast pipe takes this principle a stage further but it is found that the steam flow from the five jets through a single chimney renders the ejector design more complex. It is also observed that there is a greater tendency to throw sparks with this arrangement.

The New Zealand Railways adhere to the conventional type of single circular orifice.

The type of exhaust arrangement pre-

ferred by the Norfolk and Western Railway consists of an annular ported nozzle in conjunction with a large chimney. The only exception is the class SI which has a basket bridge with relatively small chimney. See Annexure G/14. Annexures G/15 and G/16 show examples of the usual smokebox and draughting arrangement.

This Railway has found that the annular ported nozzle induces sufficient air to ensure free steaming and to completely seal a large chimney with a minimum back pressure on the cylinders. It has also been found, for a given air flow, that the cross-sectional shape of the annular parts does not affect the back pressure nearly as much as turbulance in steam flow caused by sharp edges and roughness on the entering side of the exhaust nozzle, and due attention is paid to this aspect of the design.

SUMMARY.

Apart from the conventional type of blast pipe arrangement there is some favour found for the annular type of blast pipe cap and the multiple jet blast pipe. The latter has been used with success on 2, 3 and 4 cylinder locomotives which previously did not steam well.

H. DISTRIBUTION.

The British Railways express a preference for the Walschaert valve gear with inside admission, based on its simplicity and robustness and the fact that it gives, in conjunction with a suitable lead, a distribution which enables a locomotive to be worked efficiently between long cut-offs of, say, 60 %, and short cut-offs, say, 20 % or less. Approximately 6 700 locomotives are fitted with this gear.

The British Railways report good results with conjugated valve gear in the case of four cylinder, simple expansion, locomotives where the adjacent cylinders on each side of the locomotive are driven by a common valve gear, one valve being driven by means of a rocking lever. This arrangement is now considered preferable to the independent valve gear which introduces additional mechanism.

For 3 cylinder locomotives conjugated valve gear of the Gresley 2 : 1 type is still in use, but includes additional pins and linkages with the result that there is some tendency for the valve, receiving the derived motion, to overtravel at high speed as wear occurs. It is now considered preferable to use three independent sets of valve gear on 3 cylinder locomotives.

Trials have been carried out on the British Railways with « Poppet » valves of various types and the results obtained are summarised in the table on the following page.

The British Railways sum up their opinion of the different types of valves and valve gear used, and as referred to above, as follows :

a) *Ordinary piston valves.*

These give the simplest arrangement and are the cheapest in first cost. The distribution, in conjunction with a suitable valve gear is satisfactory but attention is required at valve and piston examinations every 54 000 to 65 000 km (33 750 to 40 625 miles). At this stage it is normal practice to renew the rings. Wear takes places on the valve heads and steamchest liners, but the latter can be re-bored and oversize valve heads can be fitted.

b) *Valves with oscillating cams.*

There has been no recent application of this arrangement.

c) *Valves with rotary cams.*

These are considerably more costly initially, but the « poppet » type of valve is not subject to wear caused by rubbing surfaces and when the valve, due to hammering or steam-cutting, ceases to be steamtight there is little involved in rectifying it by grinding in.

Since the driving gear, cams, etc., consist of flood lubricated gearboxes and rotating drive shafts they function, generally,

Type	*Lentz Rotary Cam*	*Caprotti*	*Reidinger «RR»*
Results	Has given reasonable satisfaction over a number of years, but one disadvantage is that cut off can only be altered in a limited number of steps.	After initial troubles gear now giving very satisfactory results, particularly on the last 2 engines with outside drive.	Experience as yet too limited to form any conclusion. Gear is similar to Lentz in some respects, but cut-off can be infinitely varied between full and midgear.
Number of applications	45 (Reduced to 42 by conversion to Reidinger «RR» gear).	22	4 (To be increased to 6 by conversion from Lentz «RC» gear).
Maintenance . . .	Approximately equivalent to Walschaert gear, though attention to valves is slight.	Maintenance of valves and camboxes is now light and the indication is that these will run satisfactorily with little attention between shop repairs. Maintenance of inside shaft drives rather heavy, but last two engines with outside drive very satisfactory.	Too early to express an opinion, but anticipated this will be light.
Economic balance sheet	Results do not show any advantages compared with piston valves, whilst disadvantages indicate that the additional first cost is not justified.	Excellent distribution. Latest form gives results superior to long lap Walschaert gear. Excellent bypassing. Low maintenance combined with these advantages gives promising type of valve gear, but these advantages have to be weighed against initial cost which is higher than ordinary piston valve with Walschaert gear.	Too early to express an opinion but anticipated that remarks on Caprotti gear will apply.
Future plans . . .	No more locomotives are likely to be fitted.	The present experiments will continue and may be extended.	Too early to express an opinion.

under better conditions than external valve gears. On the other hand this type of mechanism is more costly both initially and for replacements.

The New Zealand Railways have 544 locomotives equipped with Walschaert gear, 82 with Baker gear, and 29 with Stephenson motion — the last mentioned being locomotives of obsolete design.

These Railways consider that there is not a great deal between the Walschaert and Baker valve gears but the latter has the merit of eliminating die block slip in the expansion link and has other small advantages which, collectively, give it a slight but definite superiority in the consideration of this Railway.

The experience with conjugated valve gears on the New Zealand Railways has been confined to 6 of their class « G » locomotives of the 3 cylinder simple expansion type, with Gresley 2 : 1 conjugated valve gear actuating the centre cylinder. The outside cylinder are served by the conventional Walschaert valve gear. On the whole this gear has been found to be unsatisfactory due, principally, to the alteration to the valve setting as between cold and hot conditions, and the inertia effects when running at speed, which cause over-running of the piston valves, and the numerous points in the whole mechanism at which wear may occur and upset the setting of the centre valve.

The Norfolk and Western Railway has standardised the Baker valve gear, due primarily to lower maintenance cost. Previous experience was with the Stephenson and Walschaert valve gears. No independent type of valve gear has been in service, nor have any trials been made with any special valve gear.

In recent years the Norfolk and Western Railway has given attention to increasing the steam lap on the class Y6 locomotive and gives the following table to indicate the alterations made :

	High pressure valve		*Low pressure valve*	
	Original	*Altered*	*Original*	*Altered*
Max. valve travel . . .	16.51 cm (6 1/2″)	16.51 cm (6 1/2″)	15.24 cm (6″)	16.51 cm (6 1/2″)
Steam lap	2.86 cm (1 1/8″)	3.49 cm (1 3/8″)	2.86 cm (1 1/8″)	3.81 cm (1 1/2″)
Exhaust clearance . .	0.64 cm (1/4″)	0.64 cm (1/4″)	1.11 cm (7/16″)	0.64 cm (1/4″)
Lead	0.32 cm (1/8″)	0.32 cm (1/8″)	0.48 cm (3/16″)	0.48 cm (3/16″)
Cut off at full travel . .	86 %	80 %	83 %	75 %

It is reported that the alterations referred to in the above table have brought about an economy in steam consumption per drawbar horsepower of about 6 % in the higher speed ranges and about 4.5 % in the lower speed ranges. The alteration has also, it is reported, resulted in a material increase in the drawbar horsepower obtainable from the class Y6 locomotives.

SUMMARY.

The British Railways and the New Zealand Railways favour the Walschaert gear with piston valves, while the Norfolk and Western Railway favour the Baker gear.

The British Railways report results obtained with different types of cam operated poppet valves. Good results with the « Caprotti » type and promising results with the « Reidinger RR » type are reported.

I. VARIOUS.

a) *Condensor for exhaust steam :* No information.

b) *Circulation of water in the boiler.*

British Railways report that no special provision is made for this, the normal circulation of the conventional boiler being considered to be reasonably satisfactory. Nicholson's thermic syphons are fitted to 139 4-6-2 locomotives but there is no indication that these have any appreciable effect on the working of the locomotives.

The New Zealand Railways make no observations under this heading but in their report refer to the fact that the class « Kb » locomotives, with boosters in the trailing engine truck, are fitted with two Nicholson thermic syphons which were provided to meet the additional steam demand imposed by the boosters.

The Norfolk and Western Railway, also, make no observations under this heading, but elsewhere in their report indicate that longitudinal arch tubes are used on most of the class A, J, Y5 and Y6 locomotives, and transverse arch tubes are used on some of the classes Y6 and on one class J. On the most recent classes A and Y6b locomotives and on two class J's, circulators are used. The class A has 6 circulators and the classes J and Y6b have 5 circulators. Fifteen of the class SI are equipped with two thermic syphons while the remaining 60 class SI and SIa have been equipped with two circulators.

c) *Preheating the air.*

Only the British Railways refer to this item and report that no attempt has been made to preheat the air entering the ashpan, but the secondary air entering through passages in the firehole doors is directed downwards on to the fire by the deflector plate. During its passage through the firedoor some preheating of air takes place.

d) *Compounding of the engine.*

The British Railways report that within the limited loading gauge available there are considerable difficulties in applying compounding to locomotives, and come to the conclusion that even under the best conditions the gain in thermal efficiency is probably insufficient to justify the additional complication.

e) *Streamlining.*

Both the British and the New Zealand Railways come to the conclusion that with the speeds that obtain streamlining confers negligible benefits in respect of economies. Streamlining does give better appearance to a locomotive, but both railways report the abolition or the modification of streamlining, where this has been fitted, in the interest of improving accessibility and thus the maintenance of their locomotives.

SUMMARY.

a) *Condensors for exhaust steam.*

No information.

b) *The circulation of water in the boiler.*

British Railways and the New Zealand Railways have certain locomotive boilers equipped with thermic syphons, although the former reports that there is no indication of any appreciable effect in the working of the locomotive. The Norfolk and Western Railway have a number of locomotives equipped with longitudinal arch tubes, while others have transverse arch tubes. More recent classes have circulators, varying in number from two to six.

c) *Steam circuits.*

No new information.

d) *Preheating of air.*

Only the British Railways refer to secondary air admitted through passages in the firehole door being so directed as receive preheat.

e) *Compounding the engine.*

Compounding is not reported upon favourably.

f) *Streamlining the locomotive.*

Streamlining is not favoured firstly because the speeds employed do not make it essential and secondly because of the drawback of inaccessibility of the mechanism.

PRESENT LOCOMOTIVE STOCK AND FUTURE TRENDS.

As at December, 1952, the total stock of locomotives, etc., on the British Railways was as follows :

Steam locomotives	18 859
Electric	58
Diesel, gas, turbine, etc. . .	211

During the next years British Railways anticipate additional electrification schemes and increases in Diesel locomotives for shunting work and rail cars for branch lines and cross-country services. Steam traction, however, is likely to remain the principal form of motive power. It is visualised that future development in steam traction will take the form mainly of building locomotives of a small number of standard types, reducing the number of types at present in the stock and eliminating those which are uneconomical, either in running costs or maintenance.

Traction problems in New Zealand appear to fall into two categories, geographically divided into the North Island and the South Island.

In the middle of the North Island grades are severe and over the single lines congestion is severe. Diesel electric locomotives, fifteen of which are in service and others on order, are expected to alleviate this problem and also to provide the extra motive power necessary. As the cost of locomotive fuel in this area is very heavy and involves long hauls the use of Diesel electrics will greatly reduce costs. It would appear that electrification of the central area of the North Island Main Trunk, under consideration for some time, is unlikely to be undertaken for some time.

In the South Island the coal mines are better placed with respect to the main areas of traffic movement and traffic density is less than in the North Island. Consequently steam traction is expected to hold the field for a long time yet.

The Norfolk and Western Railway has 448 steam locomotives in service. It currently handles nearly 95 % of its freight service, as measured by gross ton kilometres with its classes A and Y6 locomotives. The major portion of the passenger service is performed by class J locomotives.

The Norfolk and Western Railway has built its fleet of modern locomotives in its own workshops, at Roanoke, and since it naturally repairs and maintains its own locomotives it is completely self-contained mechanically. Moreover, a very high grade of bituminous coal is available from mines along the railroad. For these reasons particularly, this railway has not yet changed to any other type of locomotive and, for the future, the steam locomotive is considered to offer the best advantages.

SUMMARIES.

Broadly speaking the conclusions drawn from the report of the three railways dealt with in this addendum follow the summaries in the Main Report fairly closely. The following points, however, are of interest.

1) One railway system uses a boiler pressure of 300 lb./sq. in. (21.10 kg per sq. cm) which is appreciably higher than the pressures worked on the other railways.

RAILWAY SYSTEMS	*BRITISH RAILWAYS*			*NEW ZELAN*	
Gauge	4′-8½″ (1.435 m)	4′-8½″ (1.435 m)	4′-8½″ (1.435 m)	3′-6″ (1.067 m)	3′-6″ (1.067
Class of locomotive	L.M.R. Class 5	L.M.R. « Duchess » Class 4	L.M.R. Class 8F	J	Ja
Type of locomotives	Mixed traffic	Express passenger	Freight		
Number of locomotive	544	42	653	28	42
Average annual mileage per locomotive	39 826 miles 63 720 km	73 813 miles 118 104 km	24 759 miles 39 614 km	39 100 miles 62 600 km	42 500 mile 67 900 km
Tractive effort	25 455 lbs 11.540 m tonnes at 85 % BP	40 000 lbs 18.120 m tonnes at 85 % BP	32 438 lbs 14.7 m tonnes at 85 % BP	24 900 lbs 11.3 tonnes at 80 % BP	24 900 lbs 11.3 tonne at 80 % B
Single crew, multiple crew, or common usage	common user	common user	common user	common user	common us
Maximum distance between locomotive changes	234 miles 373 km	405 miles 647 km	137 miles 319 km	130 miles 208 km	150 miles 241 km
Maximum distance between stops	141 miles 226 km	302 miles 483 km	39 miles 62 km	86 miles 138 km	86 miles 138 km
Tonnage hauled	435 tons 442 tonnes	450 tons 457 tonnes	805 tons 819 tonnes	400 tons 405 tonnes	400 tons 405 tonnes
Profile of line					
Maximum speed	90 m.p.h. 145 km/hr.	90 m.p.h. 145 km/hr.	30 m.p.h. 48 km/hr.	50 m.p.h. 80 km/hr.	50 m.p.h. 80 km/hr.
Average speed	42 m.p.h. 72 km/hr.	55 m.p.h. 87 km/hr.	18.75 m.p.h. 30 km/hr.		25-40 m.p.
Maintenance costs per kilometre in pence (English) and French francs :					
Shops	3.759 pence (15.35 francs)	5.832 pence (23.85 francs)	5.913 pence (24.2 francs)		
Sheds	1.806 pence (7.38 francs)	2.214 pence (9.05 francs)	1.647 pence (6.73 francs)		
Total	5.565 pence (22.75 francs)	8.046 pence (32.85 francs)	7.560 pence (30.9 francs)	18.8 pence (76.8 francs)	9.8 pence (40.1 franc

NOTES : re New Zealand Railways locomotives.

(1) Of the locomotives listed above the 28 class J, 20 of the 42 class Ja and 6 class Kb locomotives are coal burning the balance are oil burners.

UP-TO-DATE LOCOMOTIVES.

VERNMENT RAILWAYS				NORFOLK AND WESTERN RAILWAY		
(1.067 m)	3'-6" (1.067 m)	3'-6" (1.067 m)	3'-6" (1.067 m)	4'-8½" (1.435 m)	4'-8½" (1.435 m)	4'-8½" (1.435 m)
Jb	K	Ka	Kb	J	A	Y6B
		Express & goods	Express & goods	Passenger	Freight & heavy passenger	Heavy freight
12	30	35	6	14	43	30
00 miles 00 km	38 000 miles 60 700 km	47 000 miles 75 300 km	31 500 miles 50 400 km	161 230 miles 257 982 km	67 250 miles 107 612 km	55 500 miles 88 788 km
900 lbs	30 800 lbs	30 800 lbs	30 800 lbs (Eng.)	80 000 lbs	114 000 lbs	152 205 lbs simple
3 tonnes	14.0 tonnes	14.0 tonnes	14.0 tonnes (Eng.)	36.29 m tonnes	51.71 m tonnes	69.04 m tonnes simple
80 % BP	at 80 % BP	at 80 % BP	6 000 lbs (Boost) 2.72 tonnes (Boost) at 80 % BP			126 838 lbs comp. 57.53 m tonnes comp.
mon user	common user	common user	common user	common user	commun user	common user
) miles 3 km	91 miles 146 km	165 miles 264 km	100 miles 161 km	680 miles 1 088 km	259 miles 414 km	241 miles 386 km
5 miles 3 km	86 miles 138 km	60 miles 97 km	52 miles 84 km	104 miles 166 km	135 miles 216 km	135 miles 216 km
) tons 5 tonnes	500 tons 510 tonnes	500 tons 510 tonnes	500 tons 510 tonnes	1 180 tons 1 200 tonnes		
				1 : 71.5 max. grad.		
m.p.h. km/hr.	50 m.p.h. 80 km/hr.	50 m.p.h. 80 km/hr.	50 m.p.h. 80 km/hr.	100 m.p.h. 160 km/hr.	70 m.p.h. 110 km/hr.	50 m.p.h. 80 km/hr.
5 km/hr.)	depending on locality					
6 pence 8 francs)	24.7 pence (102.0 francs)	15.9 pence (65.0 francs)	26.8 pence (119.5 francs)			

(2) The class Kb locomotives are fitted with boosters.
(3) Maintenance costs include both depot repairs and overhauls separate costs are not available. (£ N.Z. 1 = £ Stg. 1).
(4) The low maintenance costs for the class Ja locomotives is due to new locomotives going into service.

2) There is no departure from the conventional type of boiler.

3) Only one of the three railways uses mechanical stokers to any appreciable extent, because of the large capacities of their boilers.

4) One railway obtains a life of from 10 to 15 years for their cast iron grates which is very much longer than is obtained on other railways.

5) Only one railway reports the use of « E » type elements in some of their locomotives.

6) One railway uses centrifugal dryers in conjunction with multiple valve regulators.

7) Exhaust steam injectors are used to a large extent on two of the railways while the third is strongly in favour of pump type feed water heaters.

8) Only one railway reports being in such a favourable position in respect of good quality water that water treatment is only necessary to a very limited extent.

9) There is not the same uniformity in the choice of the type of boiler lagging as was the case of the railways dealt with in the Main Report.

10) Although the conventional type of circular blast pipe is used in the majority of cases, the annular type of blast pipe cap and the multiple jet blast pipe are favoured in some cases in order to improve the steaming qualities of the boilers.

11) Two of the railways favour the Walschaert type of valve gear, while the third favours the Baker gear.

12) Thermic syphons are used to a limited extent on two of the railways. On the third circulators have found favour in its more modern locomotives.

ANNEXURES

General charasteristic

Railway Company	*Class of locomotives*	*Type of locomotives*	*Cylinders*			*Piston stroke*
			High pressure	*Low pressure*	*Diameter*	
British Railways	WR «Hall»	Simple Expansion	2 outs	—	1′ - 6½″ 470 mm	2′ - 6″ 762 mm
	WR «County»	»	»	—	1′ - 6½″ 470 mm	2′ - 6″ 762 mm
	BR Standard Cl. 7	»	»	—	1′ - 8″ 508 mm	2′ - 4″ 711 mm
	BR Standard Cl. 4	»	»	—	1′ - 6″ 457.2 mm	2′ - 4″ 711 mm
	E & N.E.R. « V2 »	»	1 ins. 2 outs	—	1′ - 6½″ 470 mm	2′ - 2″ 660 mm
	S.R. «Merchant Navy »	»	1 ins. 2 outs.	—	1′ - 6″ 457.2 mm	2′ - 0″ 610 mm
New Zealand Government Railways	C	»	2 outs.	—	1′ - 2″ 356 mm	1′ - 10″ 559 mm
	J, Ja, Jb	»	»	—	1′ - 6″ 457 mm	2′ - 2″ 660 mm
	K, Ka	»	»	—	1′ - 8″ 508 mm	2′ - 2″ 660 mm
	Kb.	»	»	—	1′ - 8″ 508 mm	2′ - 2″ 660 mm
Norfolk and Western Railway	A	Simple expansion articulated	4 outs.	—	2′ - 0″ 610 mm	2′ - 6″ 762 mm
	J	Simple expansion	2 outs.	—	2′ - 3″ 686 mm	2′ - 8″ 813 mm
	SIa	»	»	—	2′ - 1″ 635 mm	2′ - 1″ 711 mm
	Y6b	Compound expansion Mallet	»	2 outs.	HP 2′ - 1″ 635 mm LP 3′ - 3″ 991 mm	2′ - 8″ 813 mm

omotives.

APPENDIX N° 1.

Type valve gear	*Diameter of coupled wheels*	*Maximum speed*	*Theoretical tractive effort at tender drawbar*	*Formula used for calculating tractive effort*	*Service worked*
	6′ - 0″ 1.83 m	Not specified	27 275 lbs 12 380 kg	Tractive Effort $= \frac{.85\ D^2 \times S \times P \times N}{W \times 2}$ Where D - cylinder dia. S - stroke. P - Boiler Press. N - No of cylind. W - Driving wheel dia.	Mixed traffic
	6′ - 3″ 1.908 m	»	32 580 lbs 14 780 kg		Passenger
alschaert	6′ - 2″ 1.881 m	»	32 150 lbs 14 580 kg		Mixed traffic
»	5′ - 8″ 1.73 m	»	25 515 lbs 11 560 kg		»
»	6′ - 2″ 1.881 m	»	33 730 lbs 15 290 kg		»
	6′ - 2″ 1.881 m	»	37 500 lbs 17 000 kg		Express Passenger
	3′ - 3″ 0.99 m	45 m.p.h. 72.5 km/h	15 300 lbs 6 940 kg	Tractive Effort $= \frac{.8\ D^2 \times P \times L}{D}$ Where D - cylinder dia. P - Boiler press. L - Stroke. D - Driving wheel dia.	Shunting
	4′ - 6″ 1.37 m	55 m.p.h. 88.5 km/h	24 900 lbs 11 300 kg		Express Passenger, Goods
	4′ - 6″ 1.37 m	55 m.p.h. 88.5 km/h	30 800 lbs 14 000 kg		Express Passenger, Goods
	4′ - 6″ 1.37 m	55 m.p.h. 88.5 km/h	30 800 lbs (Eng) 6 000 lbs (Boost) 14 000 kg (Eng) 2 720 kg (Boost)		Chiefly Goods
Baker	5′ - 10″ 1.78 m	69 m.p.h. 110 km/h	114 000 lbs 51 710 kg		Freight & Heavy passenger
»	5′ - 10″ 1.78 m	100 m.p.h. 160 km/h Limited to 78 mph (125 km/h)	80 000 lbs 36 288 kg		Passenger (streamlined)
»	4′ - 4″ 1.32 m	Not specified	62,932 lbs 28,546 kg		Switching
Baker Mc Gill irol	4′ - 10″ 1.47 m	50 m.p.h. 80 km/h	Simple 152 206 lbs 69 041 kg Compd. 126 838 lbs 57 534 kg		Heavy freight

Railway Company	*Class of locomotive*	*Type of locomotive*	*Year of construction or rebuilding*	*Number of locomotives*	*Boiler pressure* *kg per Sq. cm*	*Grate area* *Sq. m.*	*Total heating area* *Sq. m.*	*Super heating area* *Sq. m.*
British Railways . .	W.R. «Hall»	4-6-0	1924-1950	329	15.8 (225 lb/sq. inch)	2.52 (27.1 sq.ft)	161.4 * (1 737.5 sq.ft)	27.4 * (295 sq.ft)
	W.R. «County»	4-6-0	1945-1947	30	19.7 (280 lb/sq. inch)	2.68 (28.8 sq.ft)	159.23 (1 714 sq.ft)	23.05 (248 sq.ft)
	B.R. Standard cl. 7	4-6-2	1951-	45 still being delivered	17.58 (250 lb/sq. inch)	3.91 (42 sq.ft)	229.5 (2 474 sq.ft)	66.75 (7 118 sq.ft)
	B.R. Standard cl.4	4-6-0	1951-1953	40	15.8 (225 lb/sq. inch)	2.48 (26.7 sq.ft)	134.4 (1 444 sq.ft)	24.6 (265 sq.ft)
	E & N.E.R. «V2»	2-6-2	1936-1944	184	15.42 (220 lb/sq. inch)	3.84 (41.25 sq.ft)	225.8 (2 431 sq.ft)	63.1 (680 sq.ft)
	S.R. « Merchant Navy»	4-6-2	1941-1949	30	19.7 (280 lbs/sq. inch)	4.5 (48.5 sq.ft)	227.6 (2 451 sq.ft)	76.6 (822 sq.ft)
New Zealand Government Railways . . .	J	4-8-2	1939-1940	40	14.06	3.53	136.8	26.3
	K	4-8-4	1932-1937	30	14.06	4.45	178.6	36.4
Norfolk and Western Railway	A	2-6-6-4	1936-1950	43	21.09 (300 lb/sq. inch)	11.33 (122 sq.ft)	616.7 (6 639 sq.ft)	251.1 (2 703 sq.ft)
	J	4-8-4	1941-1950	14	21.09 (300 lb/sq. inch)	10.00 (107.7 sq.ft)	489.7 (5 271 sq.ft)	202.2 (2 177 sq. ft
	SIa	0-8-0			15.47 (220 lb/sq. in)	4.36 (46.9 sq.ft)	238.9 (2 570 sq.ft)	59.2 (637 sq.ft)
	Y6b	Mallet 2-8-8-2	1948-1952	30	21.09 (300 lb/sq. in)	9.87 (106.2 sq.ft)	456.6 (4 915 sq.ft)	137.3 (1 478 sq.ft)

* These dimensions apply to last 71 engines of the class.

Tubes				Length (between tube-plates)	Weight of the boiler empty	Weight of the boiler per sq. m. of total heating area kg per sq. m.	Type of firebox	Nature and chief characteristics of the metal used for the plates			
perheater tubes		Boiler tubes						Firebox (Firebox shell)	Combustion chamber (= inner firebox)	Smokebox	Barrel
a-er m	Number	Diameter mm	Number	m	kg						
0 8")	21 *	51 (2")	145 *	4.63 (15'-2 7/16")	18 288 (40 300 lbs)	113.3 *	Belpaire narrow	Steel BS.24/16	Copper BS.24/11	Steel BS.24/18	Steel BS.24/16
0 8")	21	44 (1 3/4")	198	3.96 (13'-0")	18 288 (40 300 lbs)	114.8	Belpaire narrow	Steel BS.24/16	Copper BS.24/11	Steel BS.24/18	2% Nickel. Steel 5 700-6 300 kg/cm²
0 2")	40	54 (2 1/8")	136	5.18 (17'-0")	25 146 (46 400 lbs)	109.5	Belpaire wide with combustion chamber	Low Alloy High Tensile steel (5350 kg/cm² min) BRS.111	Copper BRS. 301	Copper Steel	Low Alloy High Tensile steel (5 350 kg/cm² min) BRS. 111
) 3")	21	44 (1 3/4")	157	3.96 (13'-0")	15 341 (33 800 lbs)	114.3	Belpaire narrow	Steel BRS.110	Copper BRS.301	Steel BRS.115	Steel BRS.110
3 4")	43	57 (2 1/4")	121	5.17 (16'-115/8")	26 212 (57 900 lbs)	116	Wide, with combustion chamber & round top	Steel BRS.110	Copper BRS.301	Steel BRS.115	Steel BRS.110
3 4")	40	57 (2 1/4")	124	5.18 (17'-0")	26 466 (58 400 lbs)	116	Belpaire wide with combustion chamber & thermic syphons	Steel BS.24/16	Colville's «Double Crown» Firebox steel	Steel BS.24/17	Colville's «Ducol» steel boiler plate 6 000 kg/cm² min.
) ?")	16	50.8 (2")	100	5.4 (17'-9")	22 300 (49 200 lbs)	163	Wide with round top	Extra soft firebox steel (Lukens or Colville Double Crown)		Steel BSS. 24-6-17	Steel to BSS 24-6-16
?")	24	50.8 (2")	124	5.4. (17'-9")	28 400 (62 600 lbs)	159					
")	239	57 (2 1/4")	57	7.328 (24'-0 1/2")	77 112 (170 000 lbs)	125		All boiler and firebox plates are carbon steel conforming to AAR specifications; no special steels are used.			
")	227	57 (2 1/4")	63	5 804 (19'-2 1/2")	—	—					
?")	36	57 (2 1/4")	181	4 572 (15'-0")							
?")	60	57 (2 1/4")	223	7 331 (23'-05/8")							

Weight of boiler in service per kg/hr of steam produced.

Railway	*Class of locomotive*	*Weight of boiler (kg)*	*Boiler pressure*	*Maximum steaming capacity (kg/hr).*		*Weight of boiler per kg/hr. of steam*
Norfolk and Western Railway	A	77 112	21.1 kg/sq. cm 300 lb/sq. in.	52 619		1.47
				Without self-cleaning plates	*With self-cleaning plates*	
British Railways	BR Standard Class 7 4-6-2	35 000	17.58 kg/sq. cm 250 lb/sq. in.	—	13 600	2.57
	BR Standard Class 4 4-6-0	20 900	15.8 kg/sq. cm 225 lb/sq. in.	—	8 900	2.35
	SR « Merchant Navy »	36 000	19.7 kg/sq. cm 280 lb/sq. in.	15 100	—	2.38
	E. and N.E.R. V2 Class 2-6-2	35 300	15.42 kg/sq. cm 220 lb/sq. in.	—	13 800	2.56
	WR « King » Class 4-6-0	33 700	17.58 kg/sq. cm 250 lb/sq. in.	14 500	—	2.33

Characteristics of coals used. APPENDIX A/11

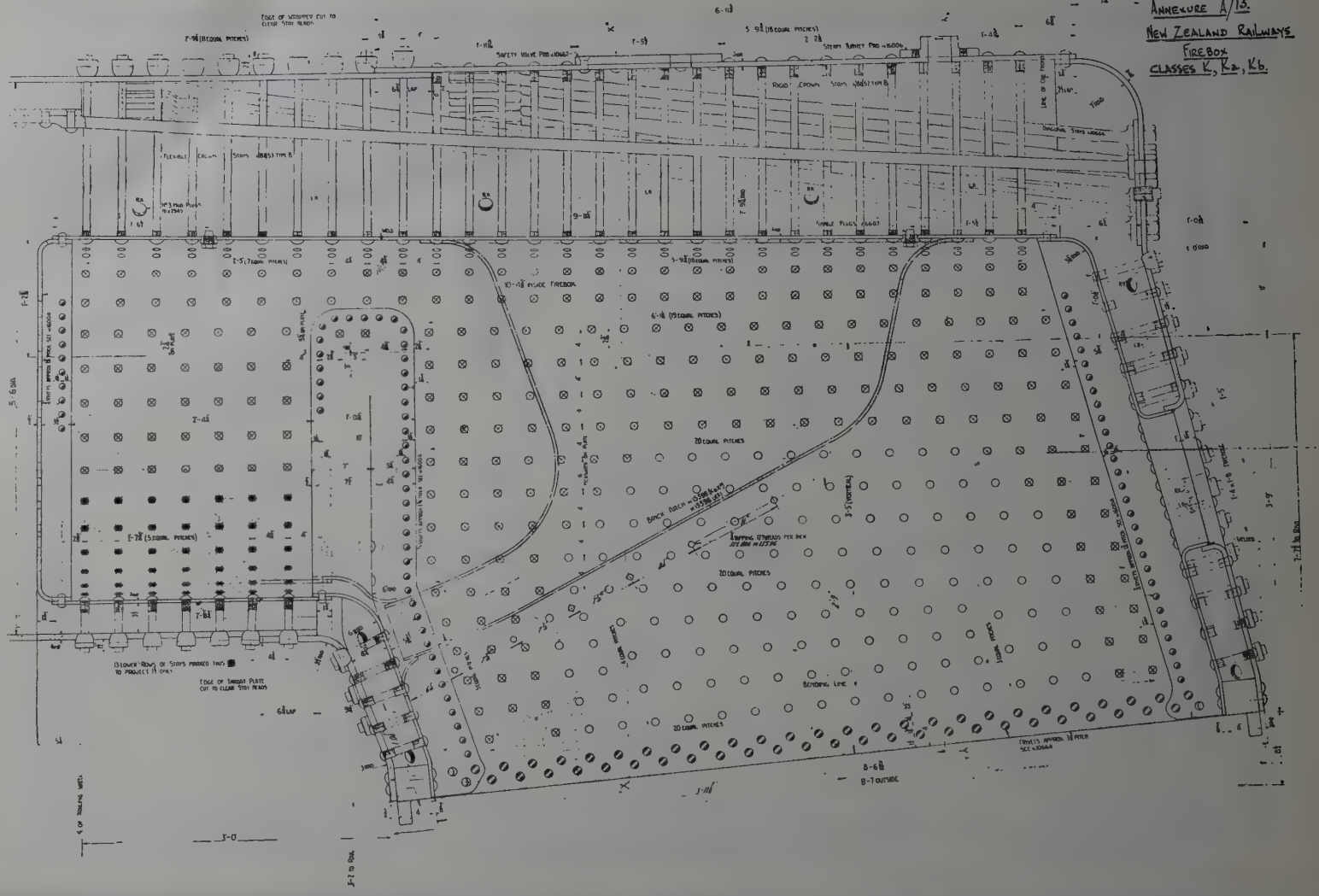
Railway system	*Type and source of coal*	*Calorific value* B.T.U/lb / K. cal/kg	*Moisture* %	*Volatile matter* %	*Fixed carbon* %	*Sulphur* %	*Ash* %	*Ash fusion temperature* °C	*Remarks*
British Railways	*South Kirby*								
	As received	13 800 7 667	3.24	34.71	57.38	1.15	4.67		
	Dry	14 250 7 920	—	35.87	59.30	1.19	4.83		
	Blidworth								
	As received	12 600 7 000	8.14	32.62	53.84	0.76	5.40		
	Dry	13 700 7 616	—	35.50	58.62	0.83	5.88		
	Bedwas								
	As received	14 050 7 805	1.1	26.6	64.3	0.65	8.0		
	Dry	14 200 7 893	—	26.9	65.0	0.65	8.1		
New Zealand Government Railways	*Millerton* Mined (bituminous)	13 960 7 750	1.1	36.0	57.1	3.3	5.8	Over 1 580	Swelling No 9 *
	Glen Afton Opencast (semi-bituminous)	10 470 5 820	18.2	38.7	41.8	0.4	1.3	1 120	Non coking
	Wilton Mined (semi-bituminous)	10 380 5 760	12.7	39.1	43.4	1.5	4.8	1 200	Non coking
Norfolk and Western	High volatile	13 800* 7 657*	5.20	37.02*	54.81*		8.17*		* Figures given on dry basis
	Low volatile	14 600* 8 116*	4.31	22.99*	70.75*		6.18*		

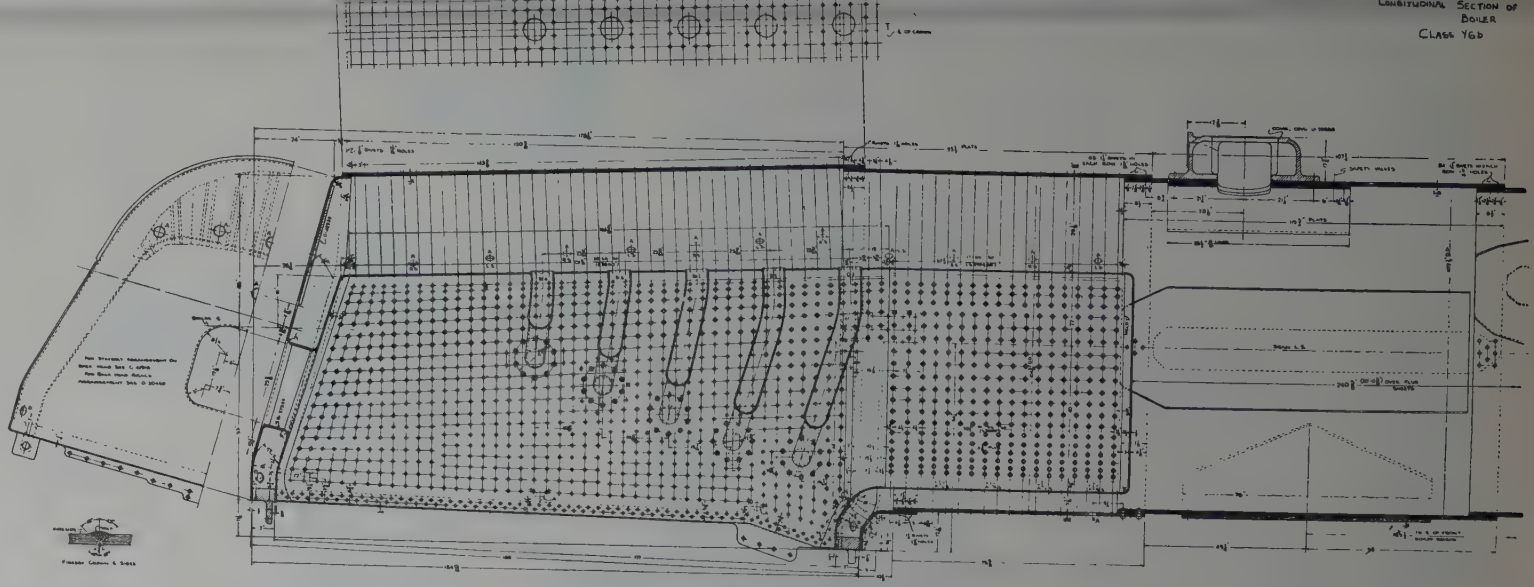
ANNEXURE A/13.

NEW ZEALAND RAILWAYS

FIREBOX

CLASSES K, Kb, Kb.

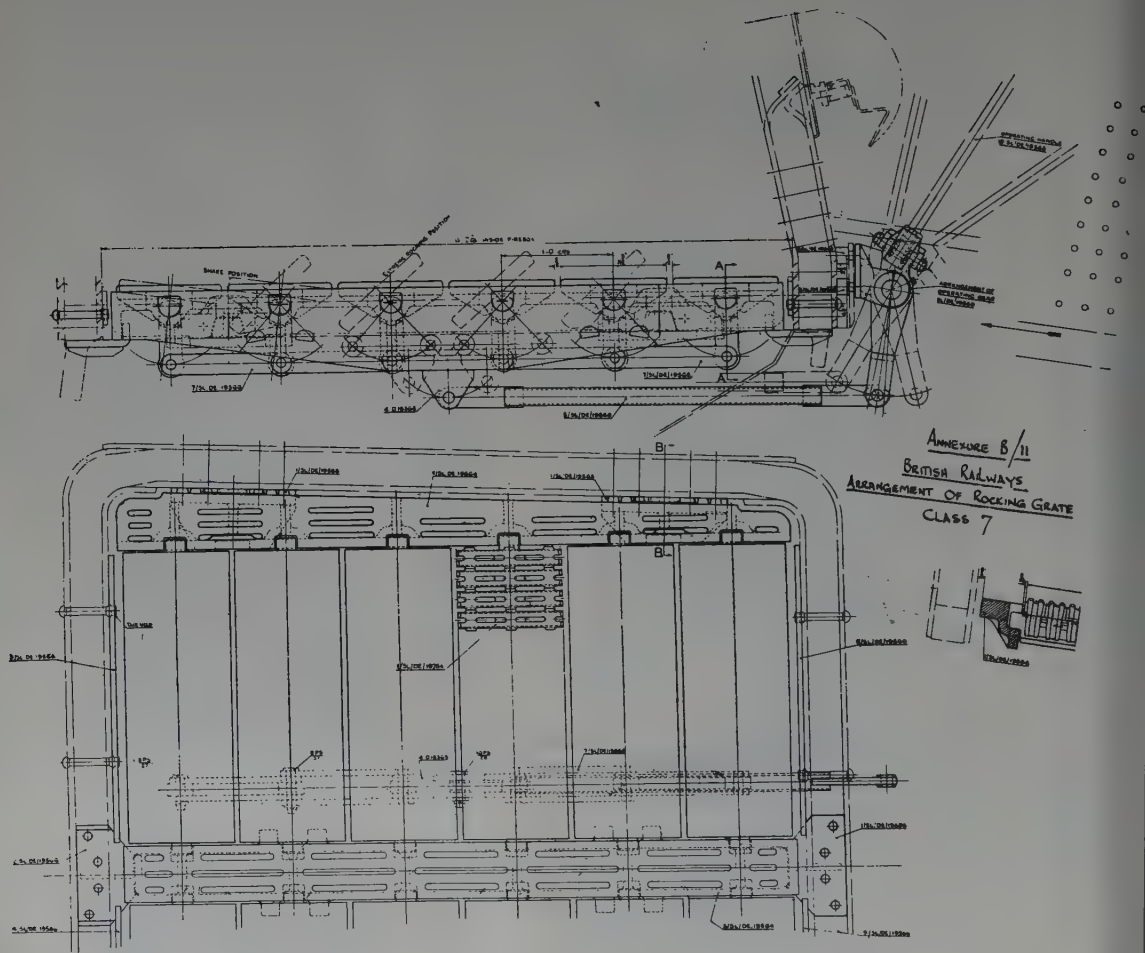


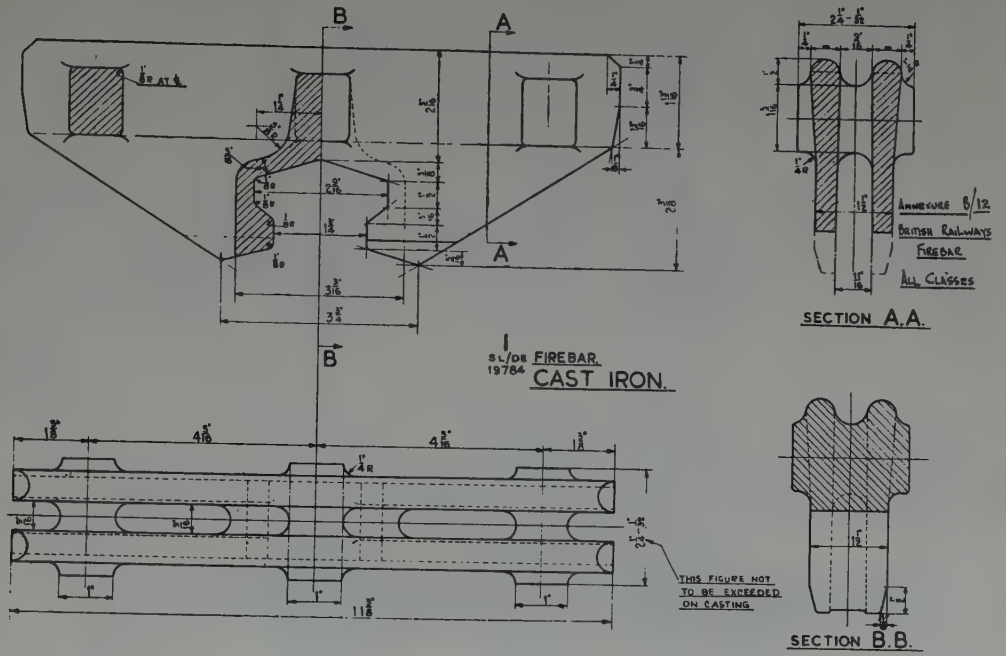


ANNEXURE B/10

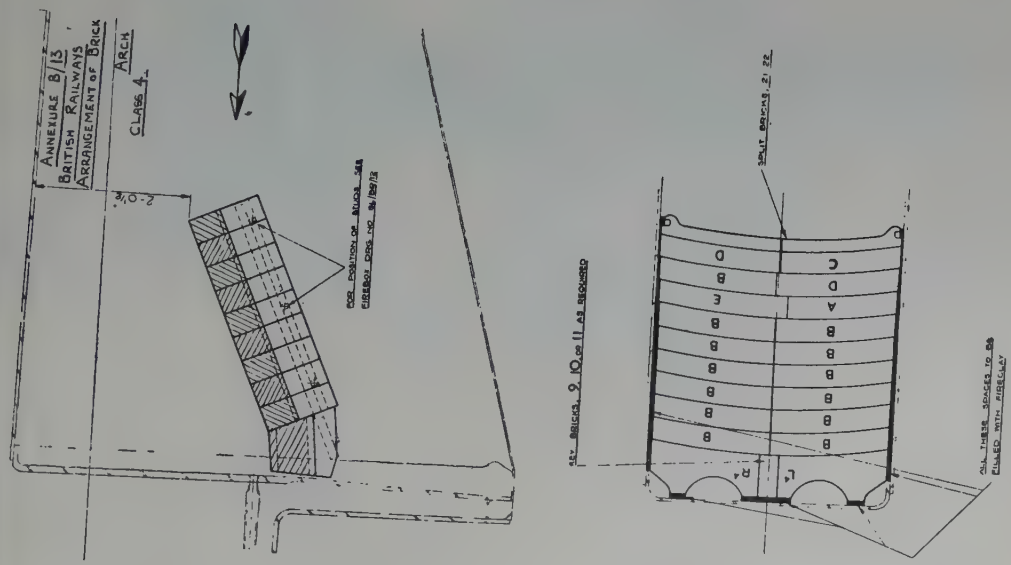
Air openings through grates and into ashpans (expressed as percentage of grate area).

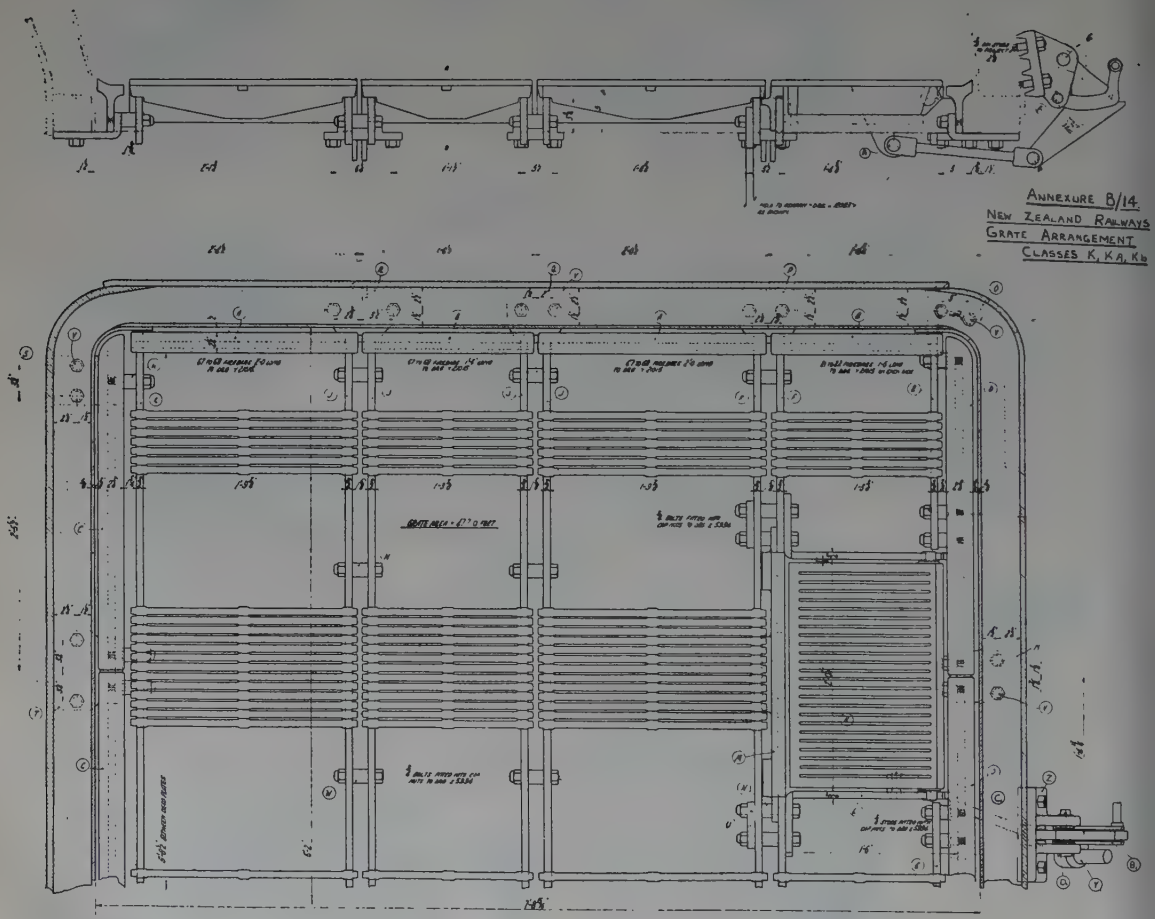
Railway	*Class of locomotive*	*Grate area*	*Free area through grate. %*	*Air area into ashpan %*
British Railways	7	3.9 sq.m 42 sq.ft.	37	8.3
	4	2.5 sq.m 27 sq.ft.	34.4	10.06
New Zealand Railways . . .	K	4.44 sq.m 47.7 sq.ft.	35.8	14.4
Norfolk and Western Railway	A	11.33 sq.m 122 sq.ft.	Table grates. 38	10.4
	J	10.01 sq.m 107.7 sq.ft.		10.0
	Y6b	9.87 sq.m 106.2 sq.ft.	Pinhole grates. 25	10.3


ANNEXURE B/11
BRITISH RAILWAYS
ARRANGEMENT OF ROCKING GRATE
CLASS 7



I
SL/DS FIREBAR.
19784 CAST IRON.





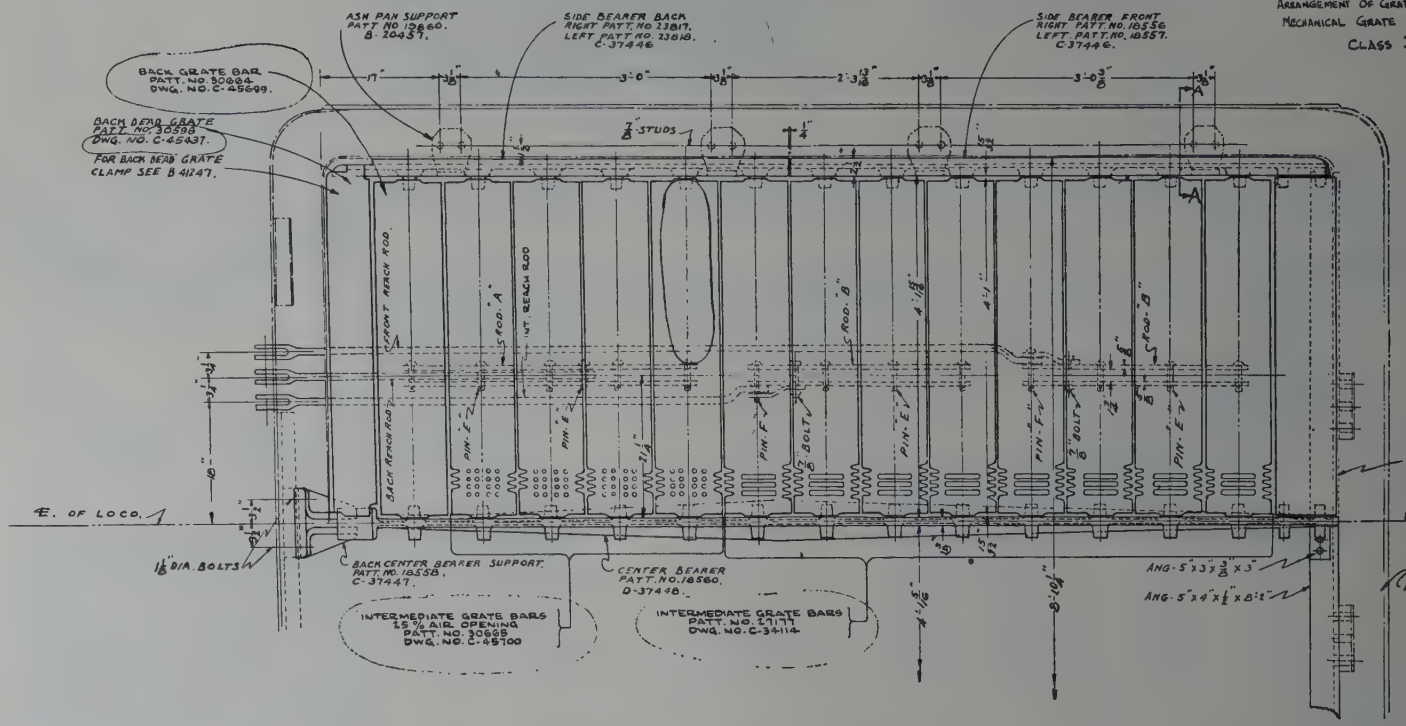
ANNEXURE B/14.
NEW ZEALAND RAILWAYS
GRATE ARRANGEMENT
CLASSES K, KA, Kb

ANNEXURE B/15

NORFOLK & WESTERN RAILWAY

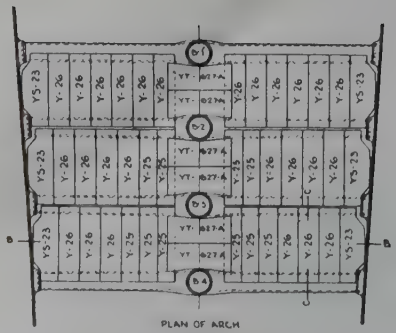
ARRANGEMENT OF GRATES & FRANKLIN MECHANICAL GRATE SHAKER

CLASS J

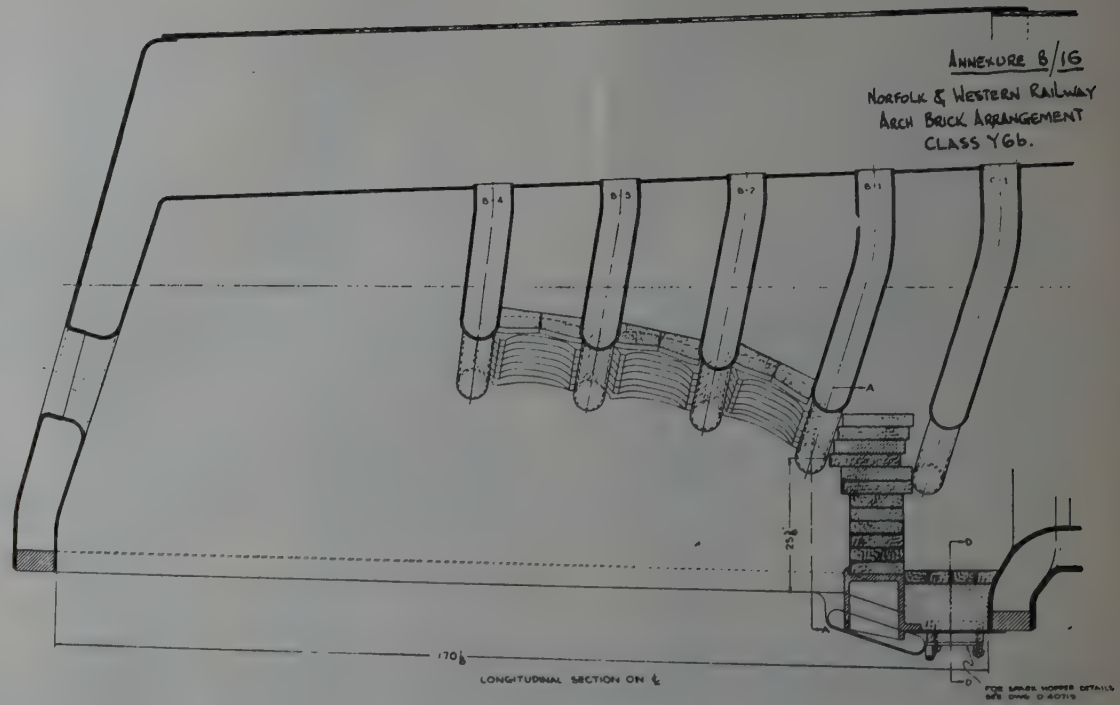

ASH PAN SUPPORT PATT. NO. 18660. B-20437.
SIDE BEARER BACK RIGHT PATT. NO. 23817. LEFT PATT. NO. 23818. C-37446
SIDE BEARER FRONT RIGHT PATT. NO. 18556 LEFT PATT. NO. 18557. C-37446.
BACK GRATE BAR PATT. NO. 30604 DWG. NO. C-45699.
BACK BEAD GRATE PATT. NO. 30593 DWG. NO. C-45437.
FOR BACK BEAD GRATE CLAMP SEE B-41247.
17"
3'-0"
2'-3 13/16"
3'-0 3/16"
7/8" STUDS
1 1/4"
FRONT REACH ROD.
INT. REACH ROD
BACK REACH ROD
ROD. "A"
ROD. "B"
PIN "E"
PIN "F"
5/8" BOLT
1/2" BOLT
FRONT BEAD GRATE PATT. NO. 29340. C-33726.
E. OF LOCO.
1 5/8" DIA. BOLTS
BACK CENTER BEARER SUPPORT PATT. NO. 18558. C-37447.
CENTER BEARER PATT. NO. 18560. D-37448.
INTERMEDIATE GRATE BARS 25% AIR OPENING PATT. NO. 30668 DWG. NO. C-45700
INTERMEDIATE GRATE BARS PATT. NO. 27177 DWG. NO. C-34114
ANG. 5"x3"x 3/8" x 3"
ANG. 5"x4"x 1/2" x 8'-2"
MUD RING D-43051.

ANNEXURE B/16

NORFOLK & WESTERN RAILWAY
ARCH BRICK ARRANGEMENT
CLASS Y6b.



PLAN OF ARCH
SCALE 1"=1'0"

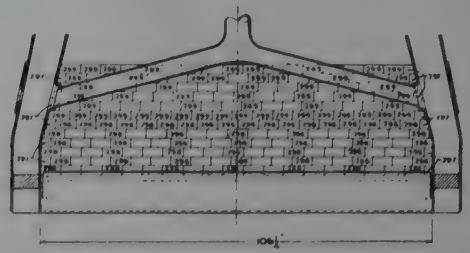


LONGITUDINAL SECTION ON ℄

FOR BRICK HOPPER DETAILS
SEE DWG D 40715

SECTION B-B

SECTION C-C



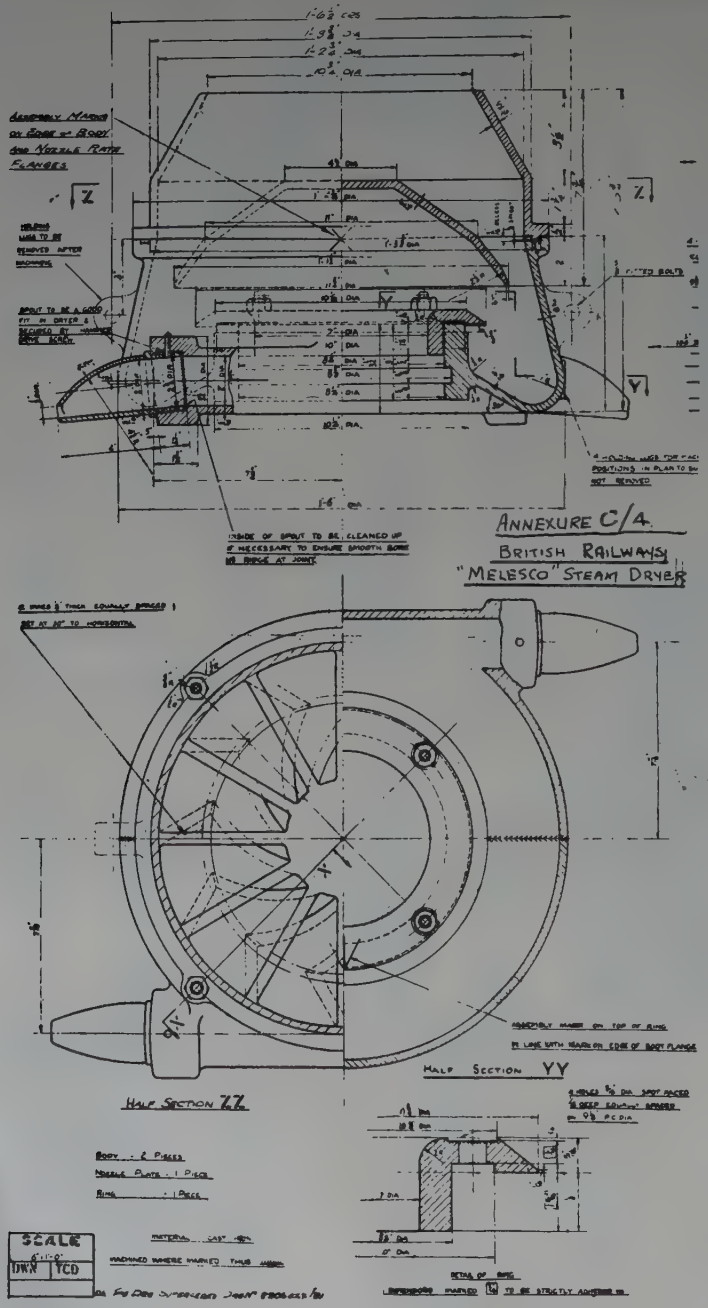
SECTION A-A
SCALE 1"=1'0"

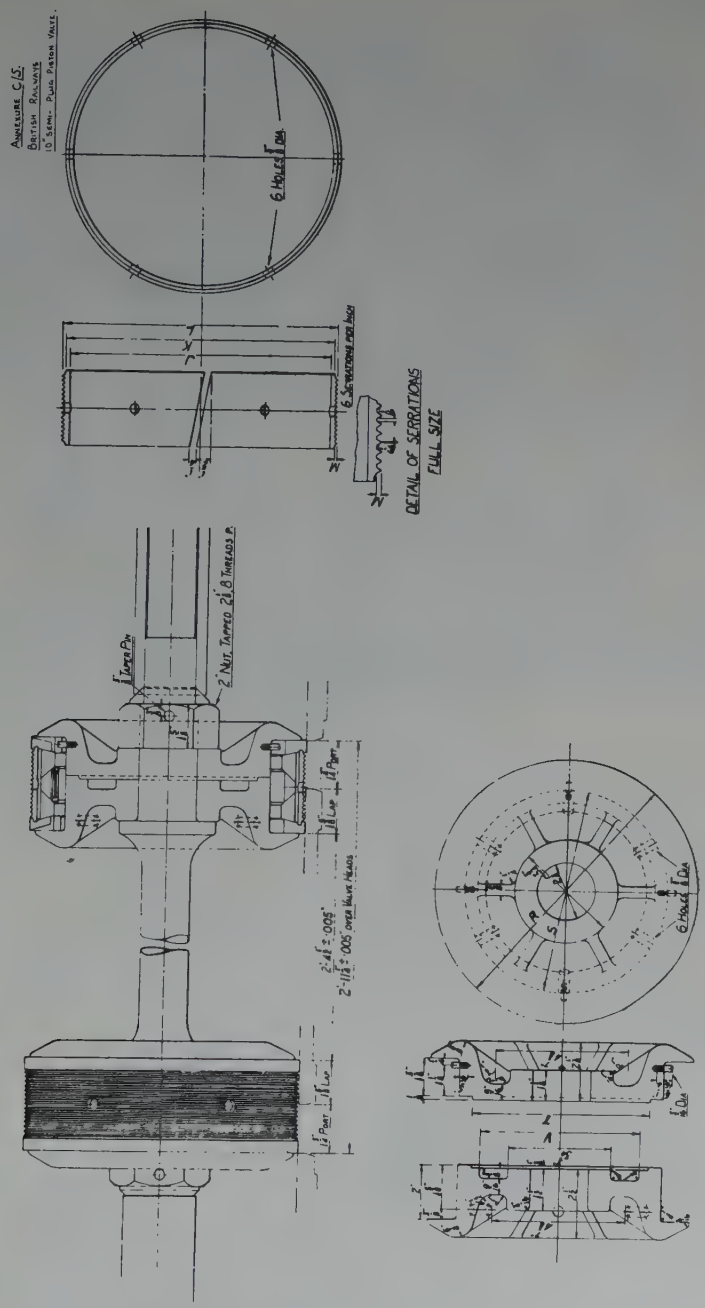
HALF SECTION D D
SCALE 1"=1'0"

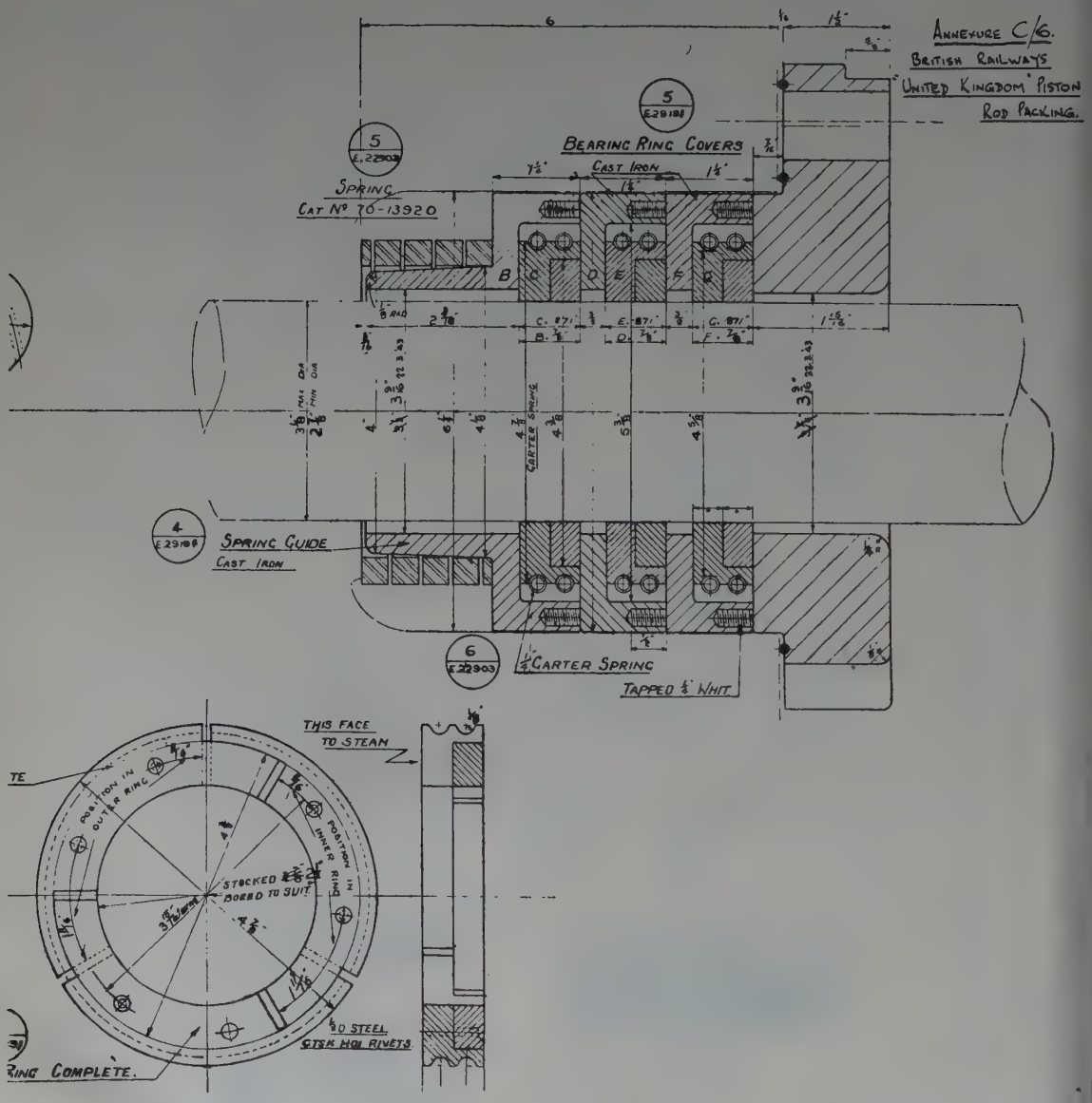
GAS AREA THRU TUBES AND FLUES 1939 SQ IN
GAS AREA OVER LIMIT CIRCULATOR 880 SQ IN

Characteristics of cylinder lubricating oils ANNEXURE C 3

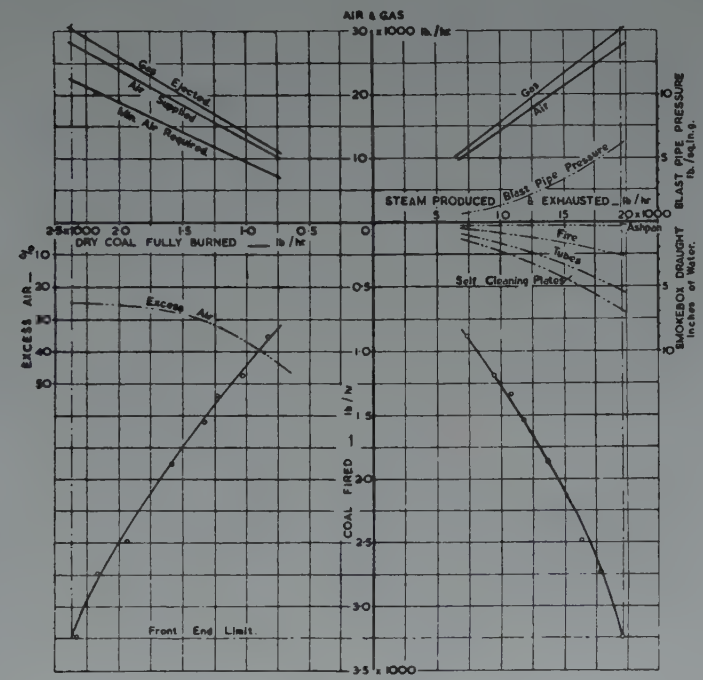
Railway	*British Railways*	*New Zealand Railways*	*Norfolk and Western Railway*
Type of oil	Compounded	Compounded	Pennsylvania base
Specific gravity	0.915 at 50° to 60° F (10° to 15.5° C)	—	24 - 27° API SGE. 60° F : .892 - .909
Flash point	Closed — Min. 510° F (265° C)	Closed — Min. 560° F (293° C)	599° F (315° C)
Viscosity	Redwood N° 1 at 200° F (93° C) — 200 - 220 *Viscosity Ratio* 4.5 max. at 140/200° F (60/93° C)	Not over 135 (Redwood N° 1) at 140° F (60° C) Not less than 165 at 210° F (99°C)	190 - 205 SSU at 210° F (99° C)
Equivalent Kinematic Viscosity - Centistokes	51.06 - 56.3 CS at 200° F	350.8 CS at 140° F 41.7 CS at 210° F	41.08 to 44.4 CS at 210° F
Pour point	Upper (Max.) I.P. 15 not higher than max. 45° F (7.2° C)	Not over 50° F (10° C)	Max. 40° F (4.4° C)
Compounding	3 % acidless Tallow.	5 % Tallow	—
Other characteristics . .	Asphaltenes : max. 0.1 %	Organic acidity (as Oleic Acid) 0.5 % max. Asphaltic matter 1.0 % max.	Max. carbon residue 1.5 %


ANNEXURE C/4.
BRITISH RAILWAYS
"MELESCO" STEAM DRYER
HALF SECTION ZZ
HALF SECTION YY
SCALE
DWN
YCD

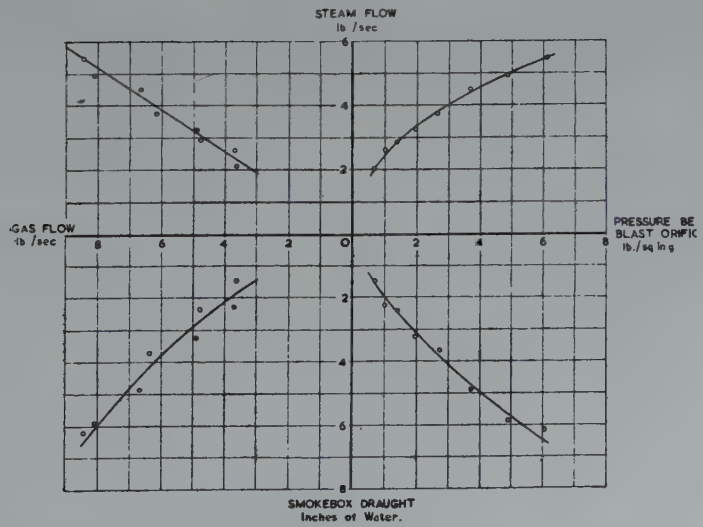

Arrangement of
British Railways
10" Semi-Plug Piston Valve.
6 Holes
6 Serrations
DETAIL OF SERRATIONS
FULL SIZE
2 Nut Turned
6 Holes


ANNEXURE C/6.
BRITISH RAILWAYS
UNITED KINGDOM PISTON
ROD PACKING.
5
E.22902
SPRING
CAT Nº 76-13920
5
E29188
BEARING RING COVERS
CAST IRON
4
E29188
SPRING GUIDE
CAST IRON
6
E22903
CARTER SPRING
TAPPED ¼" WHIT
THIS FACE
TO STEAM
POSITION IN
OUTER RING
POSITION IN
INNER RING
STOCKED
BORED TO SUIT
RING COMPLETE.

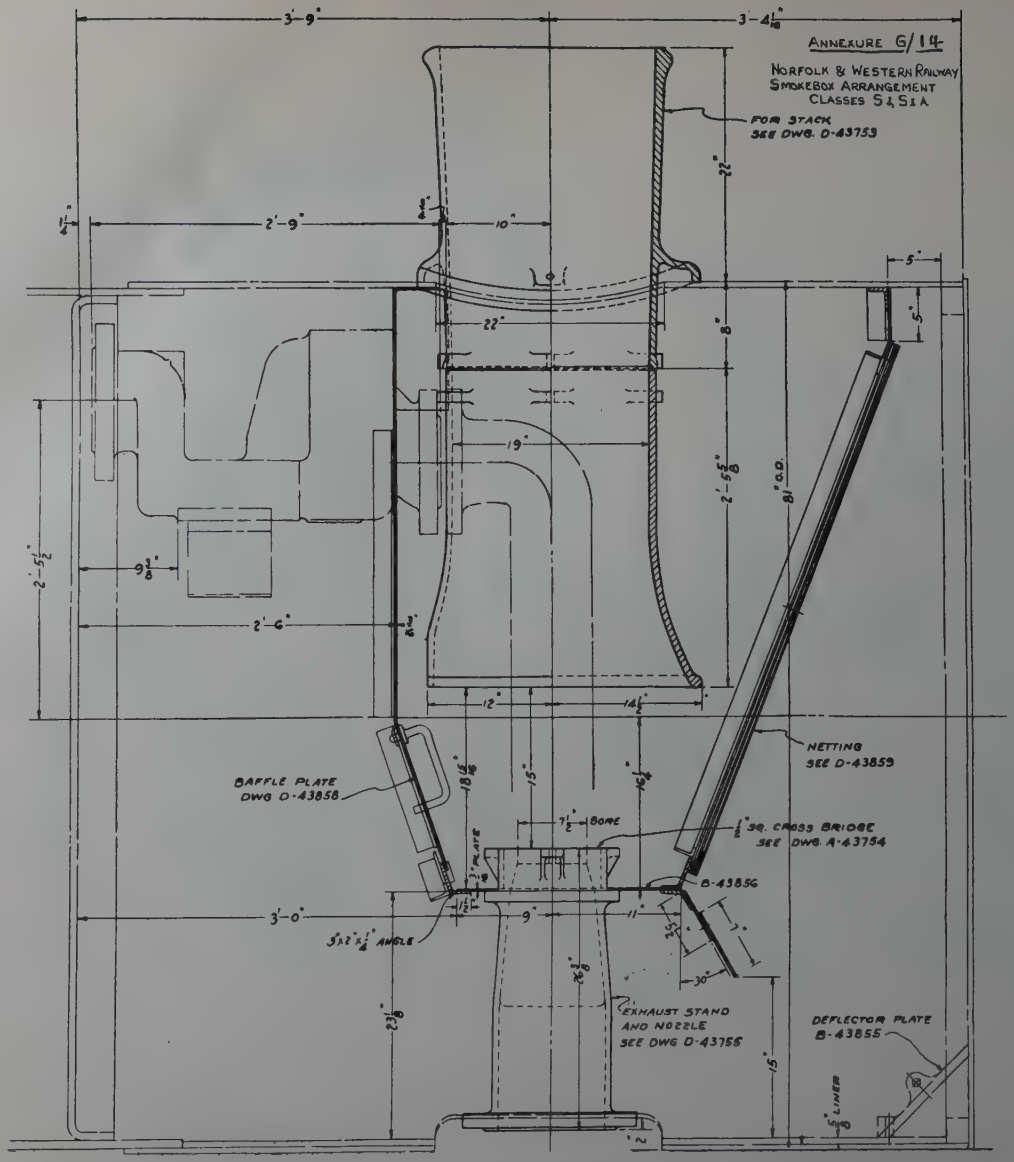
ANNEXURE G/12.



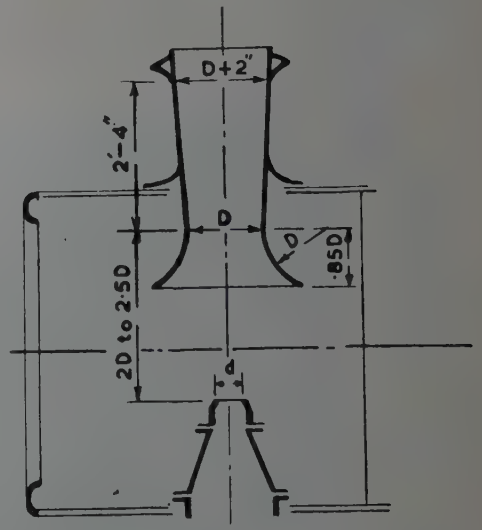
STEAM — AIR — COMBUSTION.



STEAM — GAS — DRAUGHT & BLAST PIPE PRESSURE.
BLIDWORTH COAL — 12930 B. Th.U./lb.



MIN. HEIGHT OF CHIMNEY ABOVE ℄ OF CHOKE = 2' - 4" DIMENSIONS OF CHIMNEY BELL ARE OF SECONDARY IMPORTANCE.



DIA. OF BLAST ORIFICE : —

$$d = 1.128 \sqrt{C + .008\ S} \text{ ins}$$

Where S = Evap. Heating Surface in Sq.Ft.

$C = 6.5 \pm 1.2$

Towards High Limit for Initial Superheat about 100° F and below

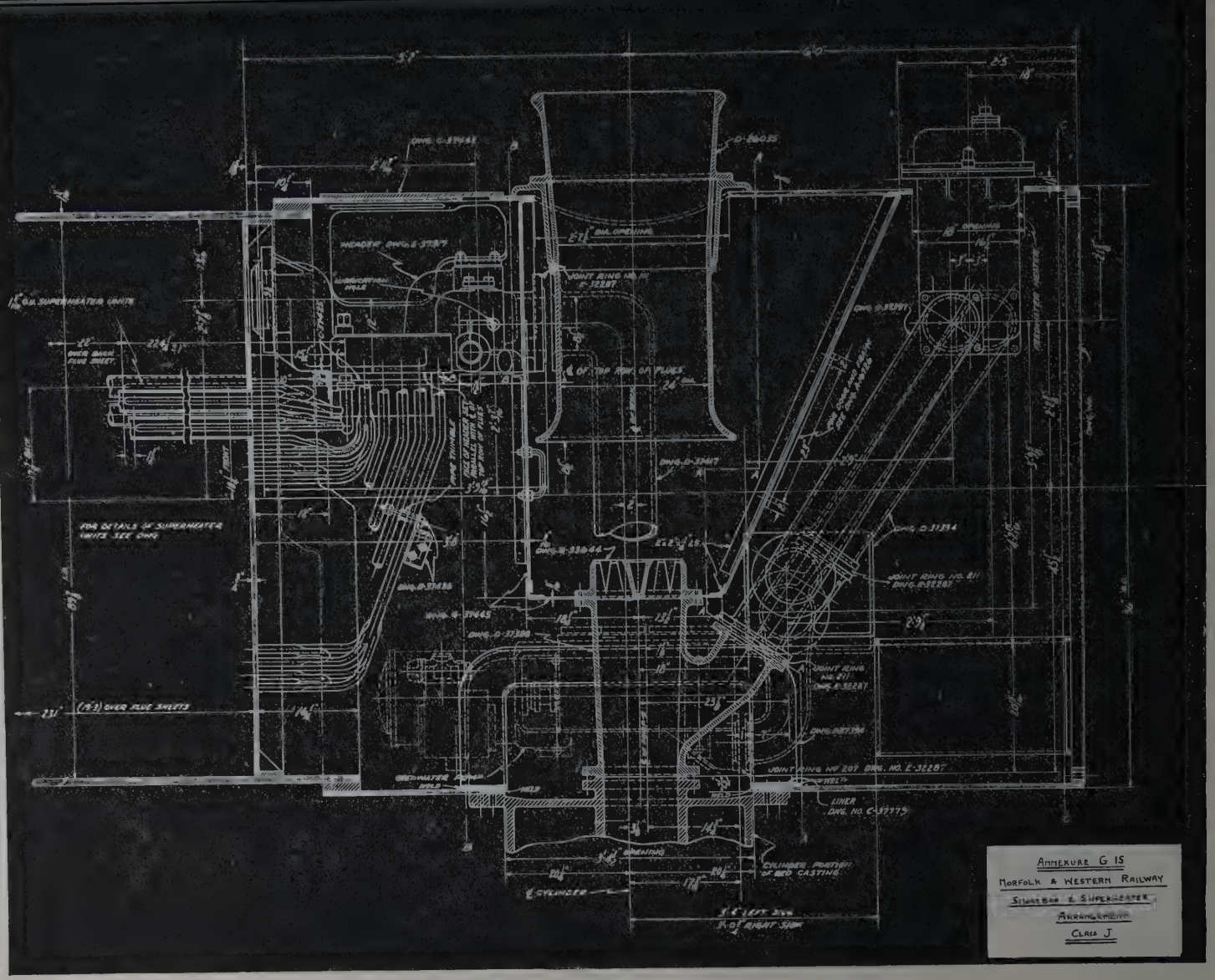
Towards Low Limit for Initial Superheat about 200° F and above

DIA. OF CHOKE : —

$D = 2.85\ d$ to $2.95\ d$

B.R. W.R.

RELATIONSHIP BETWEEN
BLAST PIPE & CHIMNEY SIZES.


DWG. C-37445
HEADER DWG. E-37387
JOINT RING NO. M
F-32287
DWG. D-37417
DWG. D-37414
JOINT RING NO. 211
DWG. E-32287
JOINT RING
NO. 201
DWG. E-32287
JOINT RING NO. 207 DWG. NO. E-32287
LINER
DWG. NO. C-37775
CYLINDER FRONT
OF BED CASTING
FOR DETAILS OF SUPERHEATER
UNITS SEE DWG
(7'-3") OVER FLUE SHEETS
DWG. D-37438
DWG. E-37445
DWG. D-37388
DWG. E-33644
DWG. D-37417
DWG. D-37414
DWG. D-37291
DWG. D-37294
DWG. D-37297
DWG. D-37296
DWG. D-37295
DWG. D-37292
DWG. D-37293
DWG. D-37290
DWG. D-37289
DWG. D-37288
DWG. D-37287
DWG. D-37286
DWG. D-37285
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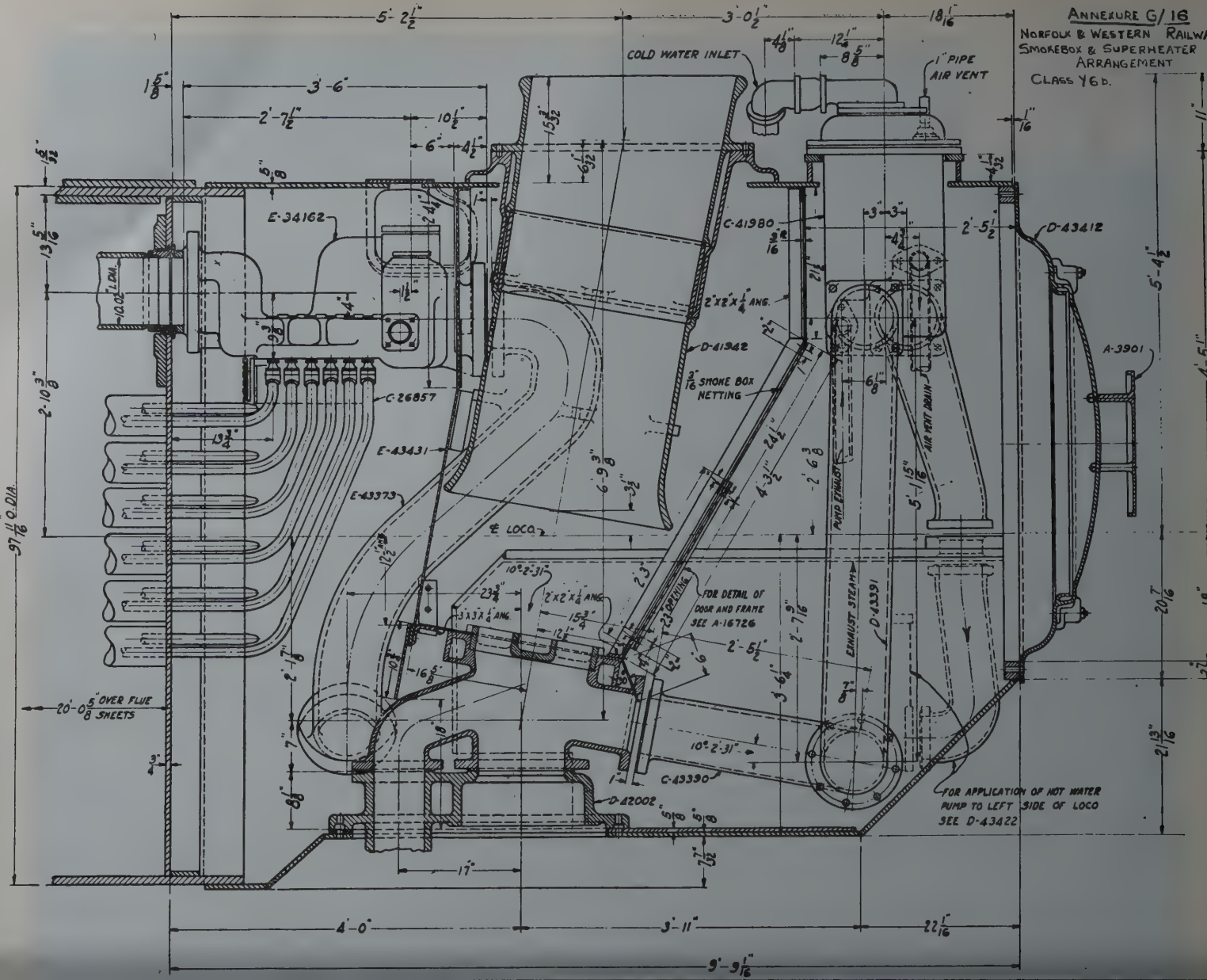
DWG. D-37273
DWG. D-37272
DWG. D-37271
DWG.

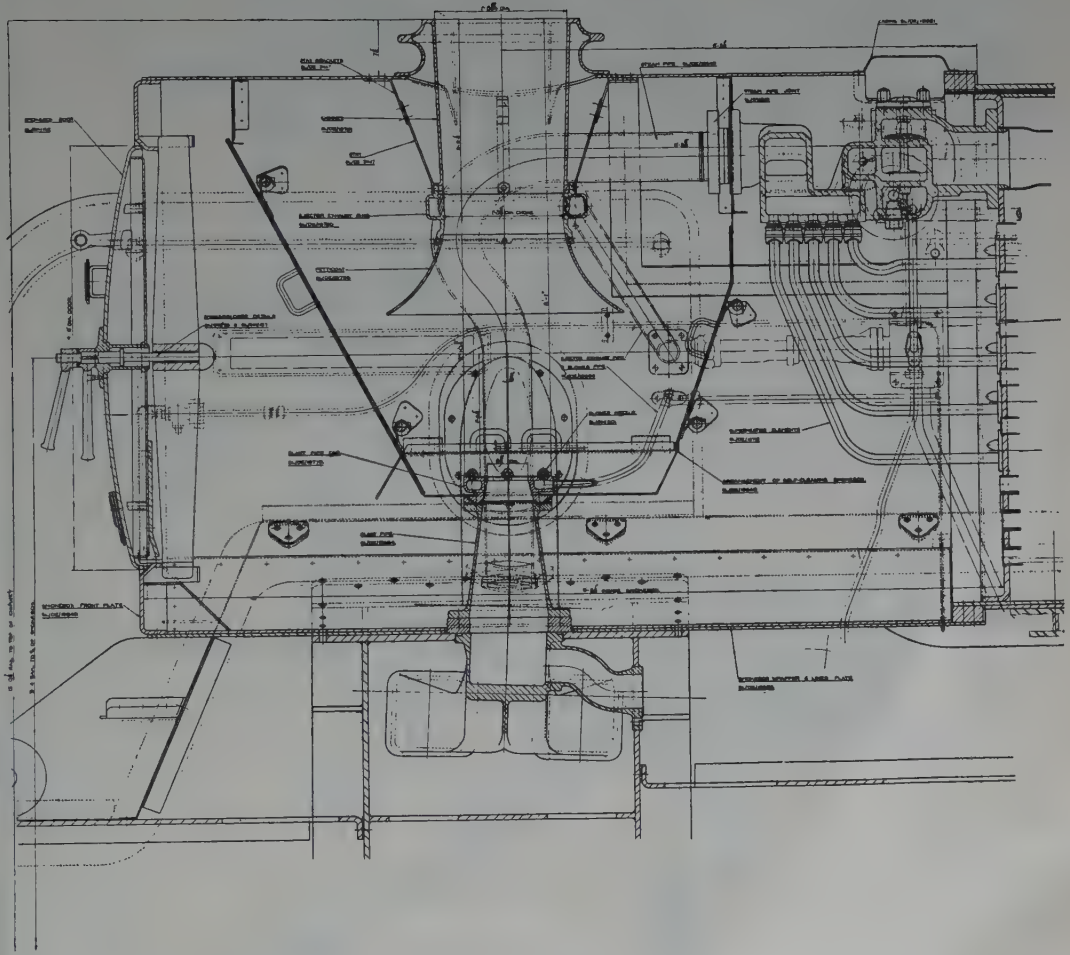

ANNEXURE G/16
NORFOLK & WESTERN RAILWAY
SMOKEBOX & SUPERHEATER ARRANGEMENT
CLASS Y6b.
COLD WATER INLET
1" PIPE AIR VENT
E-34162
C-41980
D-43412
2"x2"x¼" ANG.
D-41942
A-3901
SMOKE BOX NETTING
C-26857
E-43431
E-43373
AIR VENT DRAIN
PUMP EXHAUST
EXHAUST STEAM
D-43391
FOR DETAIL OF DOOR AND FRAME SEE A-16726
3"x3"x¼" ANG.
20'-0⅝" OVER FLUE SHEETS
C-43390
D-42002
FOR APPLICATION OF HOT WATER PUMP TO LEFT SIDE OF LOCO SEE D-43422
97 11/16" O.DIA.
4'-0"
3'-11"
9'-9 1/16"

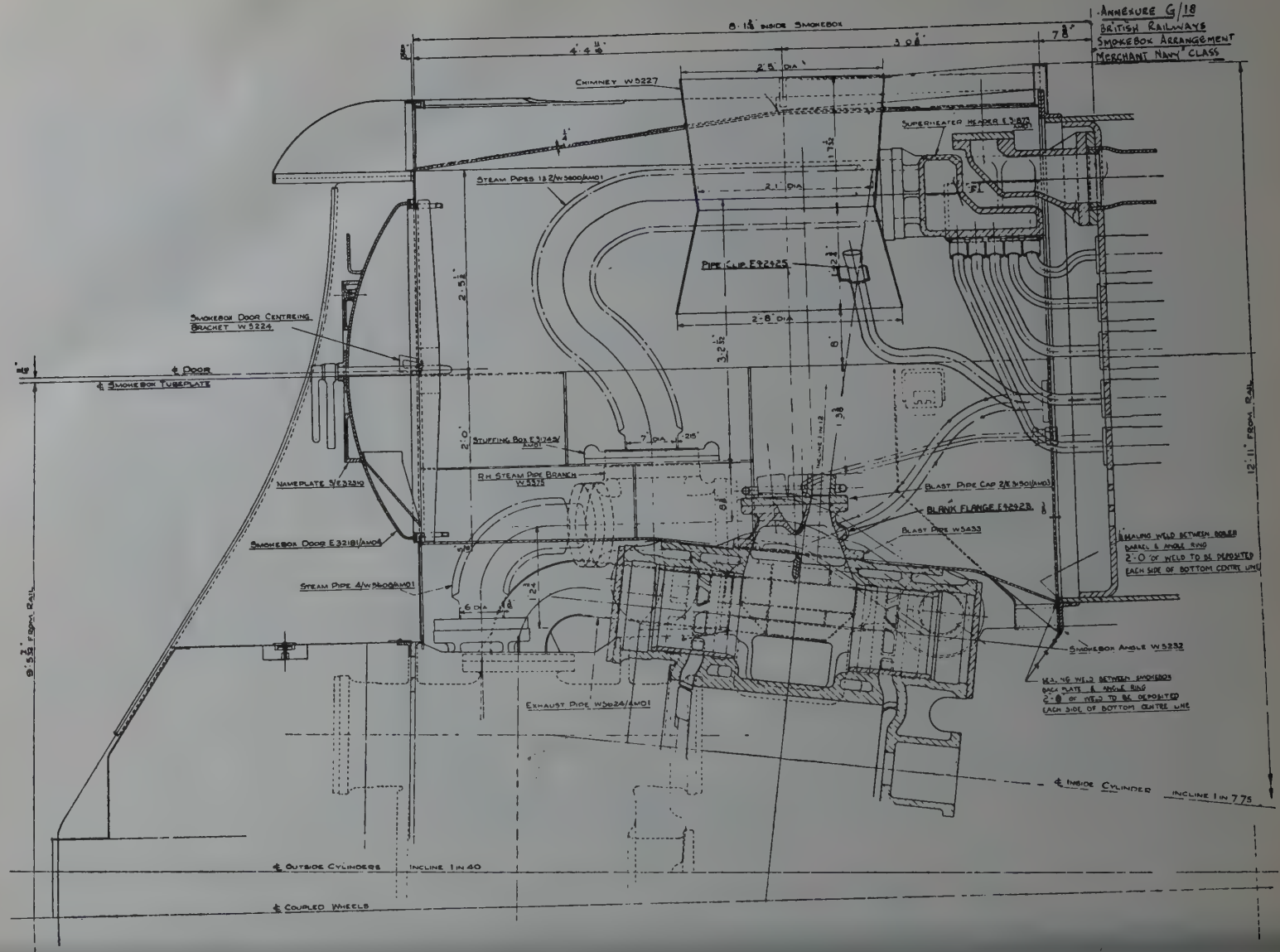
ANNEXURE G/17.

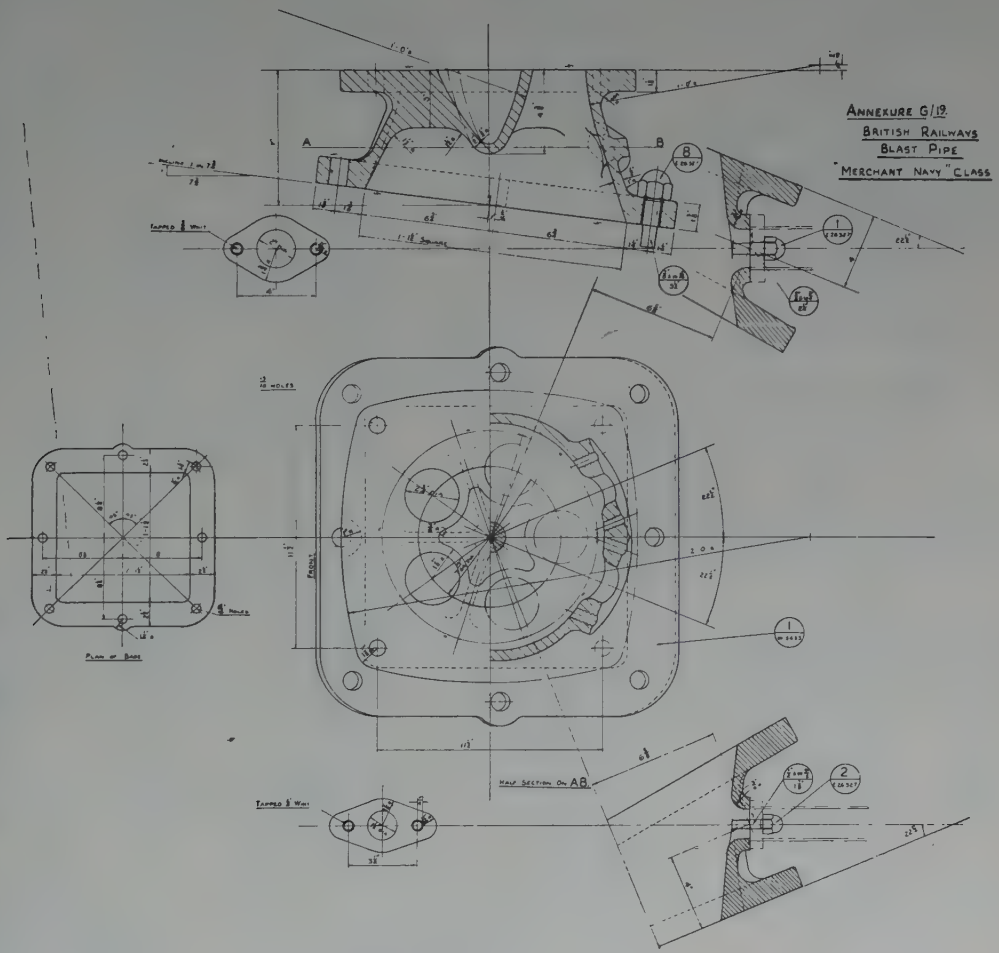
BRITISH RAILWAYS

SMOKEBOX ARRANGEMENT

CLASS. 7.




ANNEXURE G/18
BRITISH RAILWAYS
SMOKEBOX ARRANGEMENT
MERCHANT NAVY CLASS
8'-1⅛" INSIDE SMOKEBOX
4'-4 11/16"
3'-0⅛"
7⅞"
CHIMNEY W5227
2'-5" DIA
SUPERHEATER HEADER E3/8178
STEAM PIPES 1 & 2/W5600/AM01
2'-1" DIA
PIPE CLIP E92925
2'-8" DIA
SMOKEBOX DOOR CENTREING BRACKET W5224
℄ DOOR
℄ SMOKEBOX TUBEPLATE
STUFFING BOX E3/7459
7" DIA
RH STEAM PIPE BRANCH W5575
NAMEPLATE S/E32210
SMOKEBOX DOOR E32181/AM04
BLAST PIPE CAP 2/E3/501/AM03
BLANK FLANGE E92928
BLAST PIPE W5433
STEAM PIPE 4/W5600/AM01
6 DIA
SMOKEBOX ANGLE W5232
EXHAUST PIPE W5624/AM01
℄ INSIDE CYLINDER
INCLINE 1 IN 7.75
℄ OUTSIDE CYLINDERS
INCLINE 1 IN 40
℄ COUPLED WHEELS
9'-5½" FROM RAIL
12'-11" FROM RAIL


Annexure G/19
British Railways
Blast Pipe
"Merchant Navy" Class
A
B
Tapped 1" Whit
Plan of Base
Half Section on AB

Results of tests on stationary testing plant of B.R. Standard classes 7 and 4.

	B.R. Standard — Class 7		*B.R. Standard — Class 4*	
	Maximum steam	2/3 *Maximum steam*	*Maximum steam*	2/3 *Maximum steam*
Combustion activity : coal per hour	2 300 kg (5 070 lbs) (*)	1 360 kg (3 020 lbs) (*)	1 474 kg (3 250 lbs)	794 kg (1 750 lbs)
(a) Output of boiler : steam per hour	14 250 kg (31 400 lbs)	9 500 kg (20 950 lbs)	8 900 kg (19 600 lbs)	5 900 kg (13 000 lbs)
(b) Ratio of $\frac{\text{Total steam per hour}}{\text{Total evaporative surface}}$	61.9 kg/sq.m (12.68 lbs/sq.ft.)	41.3 kg/sq.m (8.46 lbs/sq.ft)	65.3 kg/sq.m (13.35 lbs/sq.ft)	4.40 kg/sq.m (9.01 lbs/sq.ft)
Ratio of $\frac{\text{Weight of water evaporated}}{\text{Weight of coal burnt}}$	5.92	6.57	6.03	7.44
(c) Superheater temperature (Admission steam)	390° C (734° F)	372° C (702° F)	344° C (651° F)	324° C (615° F)
(d) Indicated horse power (Pi)	2 200	1 570	1 330	930
at cut off %	35	25	35	20
Corresponding speed	100 km/hr. (62.5 m.p.h.)	92 km/hr. (57.5 m.p.h.)	75 km/hr. (47 m.p.h.)	87 km/hr. (54 m.p.h.)
Effective horse power (Pe, ie. Drawbar HP.)	1 720 extrapolated	1 140	1 100	580
Duration of test : minutes	70	90 — 140	60	90
(e) Efficiency of engine: $\frac{\text{Work at drawbar}}{\text{Energy in coal supplied}}$ %	6.5 extrapolated	7.5	6.4	6.4
(f) Efficiency of the mechanism $\frac{\text{Pe}}{\text{Pi}}$ %	78 (**)	73 (**)	83 (**)	62 (**)
Rolling resistance of locomotive and tender (including resistance of engine mechanism)	Approx. 9 kg/tonne (20.2 lb/ton)	Approx. 9 kg/tonne (20.2 lb/ton)	9.3 kg/tonne (20.8 lb/ton)	11 kg/tonne (24.6 lb/ton)
(g) Consumption of coal per I.H.P./hr.	1.04 kg (2.29 lbs)	0.86 kg (1.895 lbs)	1.07 kg (2.46 lbs)	0.85 kg (1.875 lbs)
Consumption of coal per D.B.H.P./hr.	1.33 kg (2.93 lbs)	1.18 kg (2.6 lbs)	1.30 kg (2.87 lbs)	1.37 kg (3.02 lbs)
Consumption of tender water per I.H./P/hr.	6.2 kg (13.66 lbs)	5.66 kg (12.48 lbs)	6.57 kg (14.5 lbs)	6.35 kg (14.0 lbs)
Consumption of tender water per D.B. H.P/hr	7.94 kg (17.5 lbs)	7.80 kg (17.2 lbs)	7.94 kg (17.5 lbs)	10.2 kg (22.5 lbs)
Characteristics of « Blidworth » coal used:				
Caloric value — as received	7 000 kg cal/gm (12 600 B.T.U./lb)		7 180 kg cal/gm (12 950 B.T.U./lb)	
Calorific value — dry	7 616 kg cal/gm (13 700 B.T.U./lb)		7 700 kg cal/gm (13 800 B.T.U./lb)	
Moisture %	8.14		6.9	
Volatile matter, less moisture %	32.62		32.7	
Fixed carbon %	53.84		56.0	
Ash %	5.40		4.4	
Total sulphur %	0.76		0.65	
Size	« Small cobbles »		50-150 mm (2″-6″) Average 100 mm (4″)	

(*) Includes exhaust steam returned to boiler by exhaust steam injector.
(**) These figures have no validity except at the speeds and cut offs mentioned.

Results of dynamometer road tests of classes A, J and Y6B locomotives.

Class of Locomotive	*Y6B*	*A*	*J*
r of road test	1950	1952	1948
of runs averaged	5	4	4 *
tance	46.6 km (29.8 miles)	178.18 km (111.5 miles)	90.11 km (56.3 miles)
rage grade %	+ 0.104	— 0.021	0 *
rage speed (running time) . . .	41.08 km/h (25.7 mph)	51.28 km/h (32.1 mph)	98.13 km/h (61.4 mph)
ling load	8 637 tonnes (8 500 E. tons)	14 237 tonnes (14 020 E. t.)	1 366 tonnes (1 345 E. ton.)
coal/Hour working	4 211 kg (9 280 lbs)	4 966 kg (10 830 lbs)	2,969 kg (6,550 lbs)
coal { per sq.m. per hour working per sq.ft. per hour working	426.7 kg 87.4 lbs	438.1 kg 89.6 lbs	296.8 kg 60.6 lbs
coal per D.B.H.P. - hour . . .	1 084 kg (2 380 lbs)	1 195 kg (2 635 lbs)	1 470 kg (3 241 lbs)
m per hour - working	34 211 kg (75 600 lbs)	38 370 kg (84 500 lbs)	24 098 kg (53 100 lbs)
m { per s.q.m. evap. surf./h work. per sq.ft. evap. surf./h work .	75.18 kg 15.4 lbs	62.2 kg 12.74 lbs	49.21 kg 10.08 lbs
m per D.B.H.P. - hour	8.80 (19.4 lbs)	9.24 kg (20.35 lbs)	11.91 kg (26.25 lbs)
m chest temperature	338 °C (640° F)	367° C (693° F)	328° C (621° F)
valent evaporation (Dry coal) .	9 641	9 441	9 731
rage D.B.H.P. (Actual) ** . . .	3 891	4 155	2 204
all Efficiency at tender drawbar	7.64 %	6.84 %	5.794 %
analysis oisture . . . . . %	3.83	3.27	2.32
latile matter (dry basis) . . %	36.40	37.76	34.70
ked carbon (dry basis) . . . %	56.98	56.27	54.28
h (dry basis) . . . . . %	6.62	5.97	11.03
ating value K-cal/kg	7 753	7 852	7 553
ating value BTU/lb	13 980	14 150	13 610
minal size - Upper	5.0 cm	5.0 cm	5.0 cm
minal size - Lower.	0.6 cm	0	0

*Two eastbound runs, average grade — 0.029 %.
*Two westbound runs, average grade + 0.029 %.
**The « horsepower » used throughout is equal to 550 foot-pounds per second by definition.

NEW BOOKS AND PUBLICATIONS.

[385 (09 (493)

LAMALLE (U.), Ingénieur des Mines, A.I. Lg., Professeur Emérite du Cours d'Exploitation des Chemins de fer à l'Université de Louvain, Membre d'Honneur de l'A.I.C.C.F. — **Histoire des Chemins de fer Belges.** *(History of the Belgian Railways)*, 3rd edition. — One volume (5 1/4 × 7 inches) of 252 pages, with 149 figures and 31 plates. — 1953, Brussels : Office de Publicité, S.A., Publishers, rue Marcq, 16.

Included in the National Collection, one of the two groups of books published by the Publicity Office, a publishing firm in Brussels, this is an extra volume. As we said when reviewing the first edition, this publicity is well justified by the great part played by the railways in the industrial and social development of our country during the long years of ever increasing prosperity. If another motive were required, it is the character of the author who both witnessed and took part in much of the progress made during the first half of this century.

Written during the occupation of the country, the author deliberately ended the history which now forms the *first volume* of this work on the 10th May 1940. In his conclusion, he expressed his conviction that this occupation would come to an end and as soon as the troubled times were over, the Belgian Railways would recover their accustomed place in the foremost rank.

In the second volume of this edition are narrated the interesting events which have occurred between 1945 and 1952. During this period, the 25th anniversary of the creation of the S. N. C. B. was celebrated, and, a remarkable achievement in the history of the system, the inauguration of the Nord-Midi Junction. But the railway is in a continuous state of evolution and these post war years were particularly fecund in new events.

These relate to all departments of railway activity : the rolling stock, the permanent way, the stations, signalling, bridges, commercial operation and social services. The author describes their essential features and gives the guiding principles and the results hoped for or already achieved.

Amongst the most spectacular items, we may mention : the achievement of the Nord-Midi Junction, extensions to electric traction, dieselisation, streamlined locomotives, railcars, new types of passenger coaches, including sleepers (another anniversary celebrated in 1951). The passenger stations which have been rebuilt according to modern ideas offer passengers the maximum facilities whilst at the same time improving the service. The goods yards have been equipped with the most up-to-date shunting equipment. In the case of signalling, the setting up of complete routes and relay posts have lightened the responsibility of the signalmen and increased the safety. The evolution of the permanent way department is towards a reduction in costs and greater aptitude for carrying the increased loads and speeds.

The illustrations, which include 31 tables at the end of the volume, are as rich as they are varied. It might be said that they present the complete history of the Belgian railways from their origins up to the present day. They bring to life the men whose creations and sensational improvements brought them a fame far outside their own country. The old and the most up-to-date stock, old and modern installations and buildings, picturesque scenes and commemorative objects of art as well as illustrations of particularly noteworthy events give a moving picture of a long century of labour and achievement.

E. M.

[385 (09 (45+494)]

LARTILLEUX (H.), ancien élève de l'Ecole Polytechnique, Inspecteur principal à la S.N.C.F. — **Géographie Universelle des Transports.** Tome II. *(Universal Geography of Transport.)* **Géographie des Chemins de fer d'Europe.** *Volume* 1 : **Suisse-Italie.** *(Geography of the European Railways. First volume : Switzerland-Italy).* — One volume (8 × 11 1/2 in.) of 284 pages, with numerous illustrations and photographs and 3 coloured maps. — 1951, Paris, Librairie Chaix, 20, rue Bergère.

After « Tome I », which dealt with the French Railways in France, North Africa and French Colonies in four volumes, the Universal Geography of Transport in « Tome II » begins to deal with the European Railways, and in this first volume those of Switzerland and Italy are described (*).

We have already explained the spirit in which this work is conceived. The author does not limit himself to describing the layout of the lines, their technical characteristics, their constitution, and their history, but also describes the regions through which they run, together with their natural resources and their industries. It is therefore indeed a *geography* which will instruct the reader. All the towns served are reported according to the position they occupy in the country, their importance, their special features, and the relations they have with the railway and the traffic they bring.

Pre-eminently tourist countries, Switzerland and Italy offer the traveller many items of distraction as well as study. They are both countries in which the construction of the railway came up against great natural obstacles. The author does not forget to point out the structures which have made it possible to cross the valleys and pierce the high mountains or even to reach their summits.

Lying as she does in the centre of Europe, several of the main international currents of traffic run through Switzerland. In addition, she has a very considerable amount o internal traffic of her own favoured by the multiplicity and density of her up-to-date methods of transport. In spite of the very mountainous nature of the country, the whole country can be reached by rail. All methods of rail transport are to be found : adhesion, rack, telpher, rope-way, etc.

In the case of Italy, like Switzerland, the author gives the history of the constitution of the present system. With great labour this has been completed and brought up-to-date during the course of years by rectifications in the layout and profile. Together with the private railway companies, it forms a whole well adapted to the needs of the country, serving the mountainous regions, the fertile valleys, the great industrial and business centres and the historical towns and ports.

As in the other volumes of the Universal Geography of Transport, the illustrations are numerous and very varied. They include a great many maps in black and white and colours showing the profile of the lines, remarkable structures, up-to-date types of rolling stock, boldly conceived aerial railways and impressive sites.

Travellers called upon to visit the countries in question would be well advised to read this book. Whilst giving them advice in the selection of the main points of their itinerary, it will also show them the great possibilities of the public transport services.

E. M.

(*) The second part of « Tome II », now in the press, will deal with Belgium, Holland, Luxemburg, Portugal and Spain. A special edition will be published of the part relating to the Benelux countries.

[625 .15 (43)]

Prof. Fr. HARTMANN, Abteilungspräsident i.R. — **Reichsbahnweichen und Reichsbahnbogenweichen.** *(Junctions and crossings on the German Railways.)* Second revised edition. — One volume (6 × 8 1/2 in.) of 213 pages, 121 figures, 9 plates and numerous tables. — 1952, Frankfurt/Main, Dr. Arthur TETZLAFF Verlag, 64, Niddastrasse. (Price, cloth bound : 16 D.M.)

This book includes the theoretical studies, description and working of the track equipment used with junctions and crossings.

After the amalgamation of the German railways into a single system, the superstructure of the permanent way was standardised. This however only covered the profiles of the rails and fastenings. The track equipment used showed various divergencies. Here therefore was material for research in order to complete the work of standardisation.

The theoretical part deals with the principles of the geometrical layout of junctions and crossings on the straight and on curves.

The description of the component parts, together with the locking devices, forms the subject of another chapter.

Then, the author deals with the use of track equipment in the various cases encountered in practice : junctions on single track, connecting lines, lead-ins to sidings.

Chapter V gives a certain number of regulations concerning the use of equipment according to the nature and use of the lines on which they are used.

Chapter VI includes the study of the geometrical layout of equipment leading off from or joining together lines laid on curves.

Finally, Chapter VII gives the calculation of the sleeper arrangement beyond the frog in the case of junctions where both lines are on a curve.

A large number of tables after the text give laying plans for various uses of standard equipment.

Both the theoretical developments and practical applications thereof contained in this book are of great interest.

E. M.

[625 .1 (436)]

Hofrat Dipl.-Ing. Dr. Techn. H. RAINER, Baudirektor der Österreichischen Bundesbahnen. — **Was bauen die Bundesbahnen ? Aufgaben und Leistungen des Baudienstes der Ö. B. B.** *(What are building the Federal Railways? Tasks and realizations of the Austrian Federal Railways.)*. One brochure (8 1/4 x 11 1/2 inches) of 32 pages, copiously illustrated. Published by the Editor of the Ployer & Co. journals, Agidigasse 5, Vienna VI.

This small book was written in order to acquaint the public with the work accomplished during the eight years since the war, by the Constructions Department of the Austrian Federal Railways.

It is by illustrations rather than by the text that the author tries to strike his readers. The many drawings which take up most of the pages show the extent of the destruction which overtook the large metal bridges, the defence works, the permanent way, the shops and stations. Examples are also shown of the modern buildings erected in the place of the ruins resulting from the war.

The author has made a table of the position of the railway at the end of hostilities. He indicates by significant figures the amount of work that had to be carried out, the points on which the first efforts

had to be concentrated, and how the lines were put back into service with remarkable rapidity.

Out of the 6 048 km (3 760 miles) of the system, 2 507 km (1 550 miles) were unusable, i.e. 41.4 %. 381 bridges of a total length of 15 645 m (9 miles) had been destroyed or badly damaged, amongst them 8 large metal bridges across the Danube. Vital installations like repair shops so essential for the restoration of the rolling stock had also suffered.

Traffic on most of the lines was restored with remarkable rapidity. At the end of 1945, 2 254 km (1 400 miles) were already reopened and 327 bridges had been made usable, at least temporarily. After the emergency measures came the period of renewal and maintenance work intended to enable the railway to operate in perfect safety again.

Reconstruction was not limited to restoring the original situation. Modern ideas guided the organisation of the work on the permanent way, the designing of metal bridges, the erection of stations and shops better adapted to service requirements and the convenience of the public. Interesting data are included on these and many other points.

These few pages give some idea of the importance of the task confronting the Constructions Department at the end of the war and the work that has been accomplished.

E. M.

[385 (05]

Jahrbuch des Eisenbahnwesens, 1953. *(Annual review of Railway Matters).* One volume (8 1/4 x 11 1/2 inches) of 200 pages, copiously illustrated. — Published by Berthold Stumpf., Francfort on Main. — Carl Röhrig-Verlag OH G, Darmstadt, Stephanstrasse, 8, (Price : 7.20 DM).

1953 is the fourth year in which this review has appeared. It is only natural that it should include in particular notes written by German authors dealing with matters of national interest. However this collection also has a more general character owing to the collaboration of foreign authors dealing with questions affecting all railways.

The editorial note deals with the position of the German Railways in 1952.

Amongst the notes whose titles indicate that they refer to the German Railways, there is a study on Diesel-engined vehicles, another on the maintenance of rolling stock and new acquisitions.

In the same category, although the ideas developed are of general application, may be included the notes on the installations at goods depots and mechanisation, the dilemma of passenger transport and the transport policy, the work of organisation for the traffic and administration.

Under the heading of international questions, we find a very extensive report of the activities of the International Railway Union, an argument in favour of a common publicity service, a review of the results of the nationalisation of the British Railways, a history of the Indonesian Railways from the point of view of the gauge of the track, and the standardised types of European wagons.

The reconstruction of Cologne Station, which is a local matter, led to town-planning problems the solution of which may interest readers of other countries.

E. M.

[385 (09 (54)]

INDIAN RAILWAYS — One hundred years, 1853 — 1953. One volume (8 3/4 x 11 1/2 inches) of 196 pages, copiously illustrated. — Published by the Ministry of Railways (Railway Board), Government of India, New Delhi.

As its title indicates, this work is intended to commemorate the Centenary of the Indian Railways.

The Bombay to Thana line, 21 miles long, was inaugurated on the 16th April 1853. At the present time, the Indian Railways extend to 34 000 miles, a large part of which is double track. It is one of the largest railway systems in the world. As other methods of transport, such as water and road, have not been developed to the same extent as in other countries, the Indian Railways will remain for many years to come the most important means of transport in India.

In homage to the pioneers and to all those who laboured to build this gigantic undertaking, the authors have given a complete history of the railway, and have drawn up a picture of its present position from various points of view.

After the preliminary discussions and difficulties, the reader assists at the creation of the different lines, the growth of the various Companies, the studies which preceded nationalisation, and the taking over of the operation by the State. A special chapter is devoted to the accumulation of obstacles which had to be overcome before the lines could be constructed. The culmination was the crossing of the Ghauts, which was a formidable problem for the engineer. One gets a clearer vision of this by the description given of a series of structures selected from amongst the most outstanding.

The book goes on to show us new ideas regarding large stations, the superstructure of the permanent way and signalling, coaches, wagons and locomotives, repair shops and even the construction of locomotives.

Electricity, the applications of which have invaded every field, including traction, made possible immense progress. The mountain lines give access to regions of great tourist value. An analysis of the passenger and freight traffic shows the benefits for which the country has to thank the railway both in the material field and from the social and cultural points of view.

The chapter dealing with the staff reports the considerable improvements made to their lot and numerous, proofs of the sollicitude of the management for its employees.

The granting of independence to India on the 15th August 1947 resulted in new problems of organisation and opened the era of great extensions. This was followed by the up-to-date work of regrouping the lines. This resulted in a considerable increase in the efficiency of the railway and progressive improvements in the services made available to the public.

A final chapter « A glimpse into the future » sums up the measures under consideration, amongst which are various technical improvements, to maintain and increase still further the efficiency of the railway.

The copious and varied illustrations include drawings showing the most interesting of ancient and modern achievements of the Indian Railways.

E. M.

[385 (08 (59)]

SANDERS (J.O.), C.M.G., M. Inst. T., A.M. Inst. C.E. General Manager, Malayan Railway. — **Federation of Malaya. Malayan Railway Administration Report for the year 1952.** — One brochure (8 1/4 × 13 in.) of 98 pages, with map. 1953, Kuala Lumpur, The Economic Printers.

This railway system which extended to 1 068 miles before the war, had fallen to 792 miles in 1946. The Japanese removed a large part of the line which left the main line to the north towards the frontier of Siam. Reconstruction has been actively pursued and by the end of 1952 the system extended to 912.6 miles. The work has continued during the year but a large bridge that had to be built at Bertam prevented any further progress being made in the train services.

In spite of this, the previous report showed a record figure for the gross receipts which exceeded those of 1950 by 23.5 %. The results for 1952 will show a further increase in spite of the unfavourable circumstances resulting from the attacks of terrorists, though these were less frequent in the second half of the year.

On the other hand, operating costs showed a further considerable rise. Owing to the insufficient production of the Malayan mines, a larger quantity of coal had to be imported. On the other hand, the staff costs were affected by the increased wages granted in 1952 and by payments made to the Staff Funds. These costs now amount to some 70 % of the total operating costs.

The 18 chapters into which the report is divided analyse the traffic and the train and locomotive mileage, as well as the position of the fixed installations and rolling stock. In the latter field, there have been some happy innovations and recent acquisitions combined with thorough overhauls of old stock have greatly increased the operating possibilities.

The Malayan Railways also run five ports, the two most important of which are Port Swettenham and Prai, served by branch lines from the main line. The activity of these ports, which is always considerable, compares favourably with 1951. A large part of the traffic is from or to the railway. Here again much progress has been made in the installations.

Chapters 17 and 18 report the staff position and sum up all the activities organised on its behalf. The major preoccupation of the health service remains the fight against malaria. Considerable success can be reported in this connection thanks to the extension of the use of the D. D. T. emulsion, the superiority of which has been recognised.

The railway system of the Malay peninsula is rapidly recovering from its war wounds and at the same time being modernised. In its present state, in spite of special unfavourable circumstances, it is showing every sign of increased activities and the prospects for future years are encouraging.

E. M.

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[72]

Un demi-siècle de progrès dans les Travaux Publics et le Bâtiment. 1903-1953. *(A half-century of progress in Public Works and Buildings 1903-1953.)* Special number published by the *Moniteur des Travaux Publics et du Bâtiment* on the occasion of the fiftieth anniversary of its foundation.— One volume (9 1/2 × 12 in.) of 400 pages copiously illustrated. — 1953, Paris (9e), Publications of the *Moniteur des Travaux Publics*, 32, rue Le Peletier. — (Price: 1 250.— fr. fr., post free: 1 400 fr. fr.)

Visitors to sites where large scale works are in progress are always struck by the machines which remove the earth, prepare the materials and transport them to site. Even on small sites it is customary to see an earth mover, a concrete mixer and an electric loader nowadays.

This general use of mechanical equipment dates from the first half of the 20th century. It has only been made possible by the perfecting and widespread use of the petrol and electric engine. Reducing considerably the amount of manual exertion required from the labourers, it has at the same time reduced the cost, and as one of the authors collaborating in this work points out, made it possible to undertake work which now becomes a paying proposition though formerly it would not have been.

Progress in the equipment is not however the only progress accomplished by the building industry, which has experienced and is still experiencing a rapid and profound evolution in all aspects of its activities.

This special issue of the *Moniteur des Travaux Publics et du Bâtiment* has as its object to report the transformation of the art of building during the course of the half century and to pay homage to the economic and social role played by the Industry.

The work is a collection of some 40 reports written by specially qualified authors, preceded by preliminary notes from three Ministers whose Departments are interested in building.

The reports deal with the organisation of the industry, materials, large civil engineering works, building and the necessary equipment, theories of stability, urbanisation, the equipment of building sites, and French achievements throughout the world.

In the railway field there is a note on the progress made in the construction of railway bridges and another on the modern equipment of the permanent way. In connection with transport in general, there are studies on the evolution of the road and road bridges, on inland navigation, and the evolution of the large maritime ports.

Without overlooking the numerous studies dealing with subjects in connection with building and constructions, it will be appreciated that special attention is devoted to the great dams and hydroelectric stations, both on account of their considerable economic interest, as well as the immense achievement which the conception and construction of these gigantic civil engineering works represent.

The *Moniteur des Travaux Publics et du Bâtiment* holds a special place in the ranks of periodicals in France. Because of its professional, technical and economic character, it has become an essential aid to all building enterprises. The beautiful volume it has now published on the occasion of its fiftieth anniversay is a further eloquent testimonial to the effective contribution it is making to the progress of the Building industry.

E. M.

[**624** (460)]

MENDIZABAL (Domingo), Civil Engineer (Roads). — **Evolución de los tramos metalicos en España.** *(Evolution of metal bridges in Spain.)* Separate reprint from the *Rivista de Obras Publicas*. Centenary number. — A brochure (8 1/4 × 11 in.) of 30 pages, illustrated. — Madrid 1953, *Rivista de Obras Publicas*, Alfonso XII, 3. — Escuela de Caminos.

This note was written at the request of the Director of the Road Engineering School for the special issue of the *Revista de Obras Publicas,* published in connection with its centenary.

The study begins by an historical review of official regulations on the construction of metal bridges in Spain and abroad. The regulations given in these instructions are arranged in three groups: the overloads

to be taken into account in the calculations, special stresses (wind, impact, temperature variations, lateral shocks, braking, centrifugal force) and thirdly the nature and properties of the materials used (iron and steel).

The evolution of the types of bridges is briefly indicated by giving the characteristics of each method of construction. When the loads increased, the strength of existing bridges became insufficient. The author explains the various ways of reinforcing them which were made use of.

Statistics covering many years show the importance of metal bridges in Spain. This can be compared with the study of the variations in prices and weights.

Amongst the new techniques, the author mentions and evaluates the use of welding, the use of tubes instead of sections for making various bridge components, and finally light alloys.

Explaining that for some twenty years reinforced concrete has tended to supersede metal structures, the author examines the causes of this change and discusses the merits and defects of the two methods.

The work ends with a study of the causes of some accidents that have occurred in Spain and by a rapid examination of the position abroad as regards stresses, impact, special stresses and types of bridges.

E. M.

[625 .113]

Dr. Ing. habil. Gerhard SCHRAMM. — **Der Gleisbogen. Seine geometrische und bauliche Gestaltung.** *(Curved track. Its geometrical form and its constitution).* One volume DIN A5, of 302 pages, 111 figures and 20 tables. — 1953. Darmstadt, Otto Elsner, Verlagsgesellschaft, Holzhofallee, 35. (Price, cloth bound: 20.— D.M.)

This work deals with various questions in connection with the geometrical form and constitution of curved track, having regard to the regulations in force on the German Federal Railways.

It is divided into nine chapters, the contents of which are given below.

The two first chapters give the principles of laying track on curves, especially those in connection with the following points: superelevation and superelevation gradients, circular curves and transition curves, the latter in terms of various profiles of gradients, the speed restrictions to be imposed in view of the curvature and superelevation.

Chapter III deals with the layout of transition curves between straight sections or curves near to one another.

The fourth chapter deals with the definition of the geometry of curves, both circular curves and transition curves, and the principles of the layout and the verification of curves on site.

Chapters V and VI deal with the calculation and layout of points and connections between straight sections and curves and between transition curves.

In chapter VII the author deals with the methods and equipment used for checking and rectifying curves.

Chapter VIII deals with various peculiarities of curved track: the gauge, widening, distance between adjoining tracks, compensating rails (short rails), marker rails, measures to be taken against displacement of the track, check rails.

The circulation of vehicles through curves and a study of the dynamic stresses they give rise to are the subject of chapter IX.

The 20 numerical tables at the end of the book give examples of the application of the theories and principles reported in the text. One of them gives the superelevations (even negative) corresponding to the radii of curvature and permissible speeds.

E. M.

[385 (05)]

Annuario de Ferrocarriles y Trasportes Regulares por Carretera, 1950-1953. *(Railway and Regular Road Transport Annual).* Publication of the Transport Institute, under the supervision of M. Alfonso Imedio DIAZ, Doctor of Law, Head of the Commercial Department of the RENFE, Head of the Railway Polytechnical Institute. — One volume (6 1/2 × 8 1/4 in.) of 586 pages. — 1953, Madrid. Instituto del Transporte, Plaza de las Cortes, 3 primeró.

The previous issue of this work related to the years 1946-49. The title has been slightly altered. Regular road transport services are explicitely included, as regards services run in conjunction with the railway. This gives a good indication of how important the organisation of transport has become in Spain.

The present enlarged edition includes in fact all the private and official organisations concerned with road transport in either an executive or control capacity.

A large part of the book is devoted to the Public Authorities. These are the various ministries upon whom the legislation now in force has imposed certain duties in connection with transport matters. Amongst them, the most important is the Ministry of Public Works, with the General Management of the railways, tramways and road transport.

Another part contains information relating to various railway systems, first of all the R. E. N. F. E. (Red National de los Ferrocarriles Españoles), then the narrow gauge State and private Railways and the metropolitan and tramway systems.

Finally, there are all the groups, and all the institutions, even those of an international character, whose activities are in any way concerned with Spanish transport.

The usual information has been completed in this annual by new data concerning the staff, statistics and a bibliography. In connection with legislation, a chronological table gives all the decrees on transport issued between 1950 and 1953.

This book is a very complete work of reference and is easy to consult thanks to the logical sequence of the contents and very careful printing.

E. M.

CORRIGENDUM

BULLETIN FOR MAY 1954. - SPECIAL REPORT by Dr. Ing. habil. G. SCHRAMM Question 1 (London Congress, 1954).

Page 502/4 :

Table giving the Railway Administrations covered by the Reports.

Col. 1.	*Col. 2.*	*Col. 3.*	*Col. 4.*
There is :			
41	Nigerian Railways	287	118
instead of :			
41	Nigerian Railways	3073	3200

MONTHLY BIBLIOGRAPHY OF RAILWAYS[1]

PUBLISHED UNDER THE SUPERVISION OF

P. GHILAIN,

General Secretary of the Permanent Commission of the International Railway Congress Association.

(AUGUST 1954)

[016. 385. (02]

I. — BOOKS.

In French.

1954 **385** (08 (493)

COMPAGNIE BELGE DE CHEMINS DE FER ET D'ENTREPRISES.

Rapports à l'assemblée générale ordinaire du 10 mars 1954. **Exercice 1953,** 73e exercice social.

Bruxelles, édité par la Compagnie ci-dessus, 33, rue de l'Industrie. Une brochure (22.5 × 29.5 cm) de 32 pages, avec statuts de la Compagnie. (18 pages.)

1954 **691**

GUYON (Y.).

Béton précontraint. 2e édition. Préface de E. FREYSSINET.

Paris, Eyrolles, éditeur. Un volume (16 × 25 cm) relié de 716 pages, avec 402 figures et 12 planches. (Prix : 4 800 fr. fr.)

1953 **624** .9

ABARRAQUE (P.).

La charpente métallique (fer et alliages légers).

Paris, Baillière et fils, éditeurs. Deux volumes (13 × 19 cm) de 280 et 192 pages, avec 565 figures. (Prix des deux volumes : 1 600 fr. fr.)

1953 **629** .1

AGARRIGUE (L.).

Organisation des ateliers et dépôts. a) Autobus et trolleybus. Rapport I du XXXe Congrès International (Madrid, 1953), de l'Union Internationale des Transports Publics.

Bruxelles, Union Internationale des Transports Publics, 33, avenue de la Toison d'Or. I. Rapport (21 × 27 cm), 220 pages + 28 Annexes, illustré. II. Plans annexes du rapport (21 × 27 cm), 23 Annexes, plans et schémas.

1953 **625** .26 : **625** .62

LÜTTICH (W.).

Organisation des ateliers et dépôts. b) Tramways. Rapport I du XXXe Congrès International (Madrid, 1953), de l'Union Internationale des Transports Publics.

Bruxelles, Union Internationale des Transports Publics, 33, avenue de la Toison d'Or. Une brochure (21 × 27 cm) de 20 pages + planches hors texte.

1953 **624** (06

Mémoires de l'Association Internationale des Ponts et Charpentes. Treizième volume.

Zürich, publié par le Secrétariat général de l'Association, Ecole polytechnique fédérale. Un volume (17 × 24 cm) de 366 pages, illustré. En vente à la Librairie Leeman, Stockerstrasse, 64, Zürich 39.

1953 **625** .143 (44)

PALMÉ (J.).

Le Rail en acier Thomas sur le Réseau de la S.N.C.F.

Paris, Office Technique pour l'Utilisation de l'Acier (OTUA), 25, rue du Général Foy. Une brochure (21 × 27 cm) de 8 pages.

1954 **621** .33 : **625** .42

Dr. Ing. V. PERRONE.

Le choix de la tension pour l'alimentation C.C. des Chemins de fer Métropolitains.

Rome, extrait de l'ouvrage : *La Metropolitana a Roma*, par le Dr. Ing. V. PERRONE. Une brochure (20.5 × 30 cm) de 10 pages.

1954 **625** .6 (06

UNION INTERNATIONALE DES TRANSPORTS PUBLICS.

XXXe Congrès International des Transports Publics. Madrid, 7-13 juin 1953. — Comptes rendus détaillés.

Bruxelles, Secrétariat Général de l'Union des T.P., 18, avenue de la Toison d'Or. Un volume (21.5 × 27.5 cm) de 136 pages, illustré.

In German.

1953 **385** .62 & **385** .63

Dr. Raphael COTTIER.

Zür Weiterbildung des internationalen Eisenbahntransportrechtes in Europa auf Grund des IUeG (CIM) und des IUeP (CIV).

Zürich, Verlag Art. Institut Orell Füssli AG. Sonderabdruck aus **Schweizerisches Archiv für Verkehrswissenschaft und Verkehrspolitik,** Nr. 3, 1953. (24 Seiten.)

1953 **621** .33

Leitfaden für den Elektrolokomotivdienst.

Wien, herausgegeben von den Österreichischen Bundesbahnen im Selbstverlag. Textband mit 357 Seiten DIN A 5. Als Beilage : ein Tafelband mit 238 Abb. (Preis : 25 Schilling.)

1953 **621** .82

Dr. phil. E. SCHMID & Dr.-Ing. R. WEBER.

Gleitlager.

Berlin/Göttingen/Heidelberg, Springer-Verlag. VIII/394 Seiten mit 212 Abbildungen. (Preis : Gzln. D.M. 45.-)

1954 **621** .133.7

Prof. Dr. A. SPLITTGERBER.

Wasseraufbereitung im Dampfkraftbetrieb.

Berlin, W. 35, Springer-Verlag. 430 Seiten mit 325 Abbildungen. (Preis : 48.— D.M.)

(1) The numbers placed over the title of each book are those of the decimal classification proposed by the Railway Congress jointly with the Office Bibliographique International, of Brussels. (See « Bibliographical Decimal Classification as applied to Railway Science », by L. WEISSENBRUCH, in the number for November 1897, of the *Bulletin of the International Railway Congress*, p. 1509.)

In English.

1953 385 (061.4
AMERICAN RAILWAY ENGINEERING ASSOCIATION.
Bulletin, No. 510, Vol. 55, September-October.
1) Field tests evaluating fire-retardant coating materials, performed by the AT & SF system; 2) Investigation of fatigue strength of railroad timber bridge stringers; 3) Static and fatigue strength of timber joints; 4) Tracking characteristics of GN electric locomotives on a 10° curve; 5) Laboratory investigation of reinforced concrete culvert pipe; 6) Features in the selection of weight of rail for new or rehabilitated lines.
Publishers : The American Railway Engineering Association, 59. East Van Buren Street, Chicago 5, Illinois. Subscription : $ 10 per annum.

1953 385 (061.4
AMERICAN RAILWAY ENGINEERING ASSOCIATION.
Bulletin, No. 511, Vol. 55. November.
1) Economics of railway location and operation; 2) Water, oil and sanitation services; 3) Highways; 4) Buildings; 5) Contract forms; 6) Yards and terminals; 7) Waterways and harbours.
Publishers : The American Railway Engineering Association, 59, East Van Buren Street, Chicago 5, Illinois. Subscription : $ 10 per annum.

1953 385 (061.4
AMERICAN RAILWAY ENGINEERING ASSOCIATION.
Bulletin, No. 512, Vol. 55. December.
1) Impact and bridge stresses; 2) Ties; 3) Masonry; 4) Maintenance of way work equipment; 5) Waterproofing; 6) Clearances; 7) Economics of railway labor; 8) Wood preservation.
Publishers : The American Railway Engineering Association, 59, East Van Buren Street, Chicago 5, Illinois. Subscription : $ 10 per annum.

1953 621 .431.72 (42)
British Railways. — Mechanical and electrical engineer's department. — **Performance and efficiency tests, Southern Region 1 Co-Co 1, 1 750 HP main-line Diesel electric locomotive.**
Edited by the Railway Executive, 222, Marylebone Road, London, N.W. 1. (Price : 10 s. net.)

1953 621 .13
DENDY MARSHALL (C.F.).
A history of railway locomotives down to the year 1831.
One volume (11 × 8 1/4 in.) of 283 pages, 105 illustrations.
Publishers : The Locomotive Publishing Co. Ltd., 88, Horseferry Road, Westminster, London, S.W. 1. (Price : £ 2.10.0 d.)

1953 656 .2
HAY (W.W.).
Railroad engineering.
One volume of 483 pages, 174 figs., 31 tables.
London : Chapman & Hall, Ltd., publishers. (Price : 60 s.)
New York : John Wiley & Sons, Inc. publishers. (Price in U.S.A. : $ 7.50.)

1953 385 (06
I.T.F.-Report 1950-1951 and proceedings of Stockholm Congress 1952.
One volume of 324 pages, illustrated. Publishers : The International Transport Worker's Federation, Maritime House, Old Toron, Clapham, London S.W. 4.

1953 691
Prestressed-Concrete statically indeterminate structures: symposium proceedings.
Edited by R.P. ANDREWS, M.A., Ph. D., and P.J. WITT. — Cement and Concrete Association, 52, Grosvenor Gardens, London S.W. 1. (Price : 25 s. net.)

016. 385. (05]

II. — PERIODICALS.

In French.

Annales des Travaux Publics de Belgique. (Bruxelles.)

1953 624 .2 & 691
Annales des travaux publics de Belgique, juin, p. 401.
PIRSON (E.). — Considérations sur les abouts de **poutre en béton précontraint.** Exposé d'une méthode de calcul basée sur l'étude des trajectoires des efforts. (10 000 mots & fig.)

1953 62 (01 & 691
Annales des travaux publics de Belgique, août, p. 509; octobre, p. 701; décembre, p. 839.
MOENAERT (P.). — Etude expérimentale de la **rupture d'une pièce longue en béton armé sollicitée par flexion plane composée non déviée.** Proposition d'une méthode de calcul. (2 200 mots, tableaux & fig.)

1953 721 .1
Annales des travaux publics de Belgique, août, p. 567; octobre, p. 755; décembre, p. 901.
VANDEPITTE (D.). — Het **draagvermogen van paalfunderingen.** (25 000 mots, tableaux & fig.)

Bulletin des C.F.F. (Berne.)

1953 **385** .586 (494)
Bulletin des C.F.F., décembre, p. 181.
Le **recrutement des apprentis de gare** aux C.F.F. (1 000 mots & tableaux.)

1953 **625** .212
Bulletin des C.F.F., décembre, p. 183.
CHERBUIN (A.) & SCHAFFNER (A.). — Les **bandages de roues** des véhicules de Chemin de fer. (1 000 mots & fig.)

1953 **656** .2 (492)
Bulletin des C.F.F., décembre, p. 184.
BAUMGARTNER (J.-P.). — La **politique des transports** des Chemins de fer Néerlandais (N.S.). (1 500 mots.)

1954 **656** .225 (73)
Bulletin des C.F.F., janvier, p. 6.
LEUENBERGER (P.) & HEGNER (F.). — **Transport par palettes de colis postaux et de colis express** du chemin de fer en Amérique. (1 000 mots & fig.)

1954 **656** .212.6 (494)
Bulletin des C.F.F., janvier, p. 11.
Les **tracteurs de gare et les chariots élévateurs** des halles aux marchandises des C.F.F. (800 mots & fig.)

Bulletin Oerlikon. (Zurich.)

1952 **621** .335 (44)
Bulletin Oerlikon, n° 293, août, p. 30.
LEYVRAZ (L.H.), BODMER (C.) & DEGEN (G.). **La rame automotrice de 1730 ch pour service de banlieue,** n° Z 9051 & ZS 19051, à courant monophasé 50 Hz, de la Société Nationale des Chemins de fer Français (S.N.C.F.). (3 000 mots & fig.)

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GLAUSER (G.L.). — **Automotrices Diesel-électriques de 1 470 ch** pour les Chemins de fer Algériens. (600 mots & fig.)

Containers. (Paris.)

1953 **656** .1 (494) & **656** .2 (494)
Containers, juin, p. 19.
TRAYTORA (V.). — La **remorque rail-route** suisse. (800 mots & fig.)

1953 **656** .225 (43) & **656** .261 (43)
Containers, juin, p. 22.
Direction Générale de la Bundesbahn. — Extension 1952 du trafic en Allemagne des **grands containers porteur aménagé.** (400 mots & fig.)

Electricité. (Paris.)

1953 **621** .31
Electricité, janvier, p. 1.
GÉNIN (G.). — La **production directe d'énergie électrique à partir du charbon.** (4 000 mots & fig.)

1953 **62** (01
Electricité, mai, p. 111.
HEMARDINQUER (P.). — Les **ultra-sons et leurs applications industrielles.** Les générateurs électriques et électroniques. (3 500 mots & fig.)

1953 **621** .33 (44)
Electricité, juillet-août, p. 149.
ARMAND (L.). — Les **électrifications** de la S.N.C.F. (Conférence de presse donnée le 6 mai 1953). (3 000 mots & fig.)

Génie Civil. (Paris.)

1954 **62** (01
Génie Civil, n° 3364, 1er janvier, p. 4; n° 3366, 1er février, p. 45.
PIRARD (A.) & SIBILLE (P.). — **Recherche des lignes de nulle pression.** (4 000 mots & fig.)

1954 **624**
Génie Civil, n° 3364, 1er janvier, p. 12.
MASSE (R.). — La **simplification des calculs hyperstatiques par l'emploi de la méthode de Mohr.** (1 000 mots & fig.)

1954 **624** .2 & **691**
Génie Civil, n° 3366, 1er février, p. 53.
LEFAUDEUX (G.). — Les **effets du fluage du béton sur les grandes poutres droites en béton armé;** surtension des armatures d'après les variations de la flèche permanente. (500 mots & fig.)

1954 **656** .261
Génie Civil, n° 3367, 15 février, p. 75.
Remorque routière de 200 t de charge utile. (800 mots & fig.)

1954 **621** .431.72 (45)
Génie Civil, n° 3369, 15 mars, p. 112.
MESNARD (G.). — Les **automotrices à moteurs thermiques** des Chemins de fer Italiens. (800 mots, tableau & fig.)

L'Industrie des Voies ferrées et des Transports automobiles. (Paris.)

1953 **621** .33
L'Industrie des voies ferrées et des transports automobiles, juin, p. 83.
BRASSEUR. — Une nouvelle technique d'électrification des voies ferrées d'intérêt général : **l'électrification en courant industriel.** (2 000 mots & fig.)

1953 **621** .431.72
L'Industrie des voies ferrées et des transports automobiles, novembre, p. 159.
GRANDVARLET (R.). — La **régulation des moteurs Diesel de traction.** (3 000 mots & fig.)

1953 **621** .431.72
L'Industrie des voies ferrées et des transports automobiles, décembre, p. 175.
ZENS. — **Locomotives Diesel à bogies 400/600 CV pour service de manœuvres et desserte des lignes secondaires.** (1 000 mots & fig.)

L'Ossature métallique. (Bruxelles.)

1953 **624** .9
L'Ossature métallique, octobre, p. 507.
MAGNEL (G.). — Les **charpentes en acier précomprimé.** (5 000 mots & fig.)

1953 **62** (01
L'Ossature métallique, novembre, p. 573.
Les **extensomètres électroniques** et leurs applications. (1 000 mots & fig.)

1954 **625** .25
L'Ossature métallique, janvier, p. 19.
PRINGIERS (P.). — Comparaison dans les conceptions coulées, embouties, soudées et rivées des **bogies de voitures.** (6 000 mots & fig.)

1954 **624** .7 (494)
L'Ossature métallique, février, p. 85.
MARGUERAT (L.). — Les **ponts-rails à poutres mixtes acier-béton** des Chemins de fer Fédéraux suisses. (3 000 mots & fig.)

Rail et Route. (Paris.)

1953 **385** (57)
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Le **Transsibérien,** voie économique et stratégique. (4 000 mots & fig.)

1953 **388** (485) & **625** .42 (485)
Rail et Route, décembre, p. 8.
HAMACHER HENSE (F.W.). — Les **transports urbains et suburbains de Stockholm.** (3 000 mots & fig.)

Revue de l'Association française des Amis des Chemins de fer. (Paris.)

1953 **621** .132.8 (44) & **621** .438 (44)
Revue de l'Association française des Amis des Chemins de fer, juillet-août, p. 77.
TEISSIER (J.). — La **locomotive à turbine à gaz** et générateur Pescara étudiée et construite par la Régie Nationale des Usines Renault. (5 500 mots & fig.)

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CAIRE (D.). — **L'évolution de la Société des Chemins de fer Vicinaux Belges.** (2 500 mots & fig.)

Revue Générale des Chemins de fer. (Paris.)

1954 **656** .215 (44)
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MICHAUX. — Les **lampes à ballon fluorescent de la gare de Chartres.** (1 200 mots & fig.)

1954 **656** .211.5 (44)
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CHEVAL & GAVAULT. — **Deux nouveaux « Centraux-Location »** de la S.N.C.F. « Paris-Montparnasse » et « Roussillon ». (2 500 mots & fig.)

1954 **385** (06.4 (43)
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FIOC. — **L'Exposition des transports et communications** de Munich. (6 000 mots & fig.)

1954 **656** .211.5 (44)
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BAUDET & JAY. — La future **gare voyageurs fer-route** de Mâcon. (1 500 mots & fig.)

1954 **621** .33 (44)
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LEFORT. — **L'électrification des lignes du Nord-Est** de la France. Deuxième étape. (3 000 mots & cartes.)

1954 **625** .172 (44)
Revue générale des Chemins de fer, mars, p. 127.
ROUSSE. — Les **trains désherbeurs à grand rendement.** (2 000 mots & fig.)

1954 **625** .245 (44)
Revue générale des Chemins de fer, mars, p. 133.
THIRIET. — Les **wagons-citernes** en France. (1 500 mots & fig.)

1954 **656** .225 (44) & **656** .261 (44)
Revue générale des Chemins de fer, mars, p. 137.
Les **cadres ou caisses mobiles** à la S.N.C.F. (1 000 mots & fig.)

1954 **656** .222.1
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Un essai comme les autres à la **vitesse de 243 kilomètres à l'heure.** (1 500 mots & fig.)

1954 **625** .23 (44) & **625** .24 (44)
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Les étapes de la **normalisation** dans les chemins de fer. (1 500 mots & fig.)

1954 **625** .42 (485)
Revue générale des Chemins de fer, mars, p. 153.
Le **métropolitain de Stockholm** avec une introduction sur la Suède et ses chemins de fer. (2 000 mots & fig.)

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1953 **625** .13 (494)
Science et Technique, n° 7/8, p. 115.
BROU (W.Ch.). — A l'occasion du vingtième anniversaire de leur inauguration... Les **tunnels sous l'Escaut.** (2 200 mots & fig.)

1953 **624** .2 & **691**
Science et Technique, n° 7/8, p. 123.
MAGNEL (G.). — Nouvel **essai de fatigue d'une poutre en béton précontraint.** (2 100 mots & fig.)

1953 **624** .2 & **691**
Science et Technique, n° 11/12, p. 183.
LAMBERT (E.). — La **pathologie du béton précontraint.** (2 500 mots & fig.)

1953 **621** .335
Science et Technique, n° 11/12, p. 196.
L'évolution de la **construction métallique des locomotives électriques.** (1 300 mots.)

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1954 **385** .524 (44) & **651** (44)
Science et Vie, janvier, p. 75.
BOMIO (R.). — **Comment sont calculées les primes** de tous les cheminots. (1 000 mots & fig.)

1954 **656** .212
Science et Vie, avril, p. 329.
CHENEVIER (R.). — Les **gares-marchés** remplaceront les Halles centrales. (1 000 mots & fig.)

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1953 **625** .13 (44)
Travaux, septembre, p. 427.
REVERDY (G.). — Les **travaux de reconstruction du pont d'Ancenis** sur la Loire. (4 500 mots & fig.)

1953 **669** .1
Travaux, septembre, p. 437.
SAILLARD (Y.). — Recherches sur les **aciers l'armatures** de limite d'élasticité 60 kg/mm². Détermination d'un acier « Tor-60 ». (8 500 mots & fig.)

1953 **624** .63 (44) & **691** (44)
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BARETS (Y.) & RUHAUD (A.). — Le pont du Bourget. — **Bow-string précontraint** de 74 m de portée. (5 500 mots & fig.)

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1953 **621** .33 (42)
La Vie du Rail, 15 novembre, p. 3; 22 novembre, p. 9.
Les Chemins de fer Britanniques et l'**électrification.** (2 000 mots & fig.)

1953 **621** .335 (45)
La Vie du Rail, 29 novembre, p. 3.
La **nouvelle rame automotrice électrique italienne.** (1 000 mots & fig.)

1953 **656** .212.7 (44)
La Vie du Rail, 13 décembre, p. 7.
La « **palettisation** » au Magasin Général des Batignolles. (500 mots & fig.)

1954 **621** .33 (438)
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Développement de l'**électrification** en Pologne. (500 mots & fig.)

1954 **621** .33 (44) & **625** .1 (44)
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DOERR (M.). — Les **travaux d'électrification 25 kV, 50 Hz** sur la section Valenciennes-Hirson de l'artère Nord-Est. (1 000 mots & fig.)

1954 **621** .335 (44)
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1953 **625** .143.4
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BÄSELER. — Die **Schienenstossverbindung System Reifurth.** (1 400 Wörter & Abb.)

1953 **621** .116
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RÄSCH (A.). — Kritische Betrachtung der **Wasserstandsanzeiger für Dampfkessel.** (2 700 Wörter & Abb.)

1953 **625** .252
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KENN (F.). — Der ungleichmässige Verschleiss am gusseisernen **Bremsklotz.** (2 000 Wörter & Abb.)

1953 **625** .151
Der Eisenbahningenieur, Oktober, S. 251.
VOLTZ (A.). — **Die Berechnung von Weichen und Weichenverbindungen in Parabeln 4. Grades.** Geschwungene Übergangs-parabel. (2 600 Wörter & Abb.)

1953 **656** .256.3
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SASSE (H.-W.). — **Sperrzeit und Signalteilung bei Selbstblock.** (3 000 Wörter & Abb.)

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KOCH (J.E.). — **Holzfäulniss und deren Bekämpfung.** (1 000 Wörter.)

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HÖER (W.). — **Wagenbegrenzungslinien, Lademasse, lichter Raum und Lademassüberschreitungen** bei Regelspurbahnen. (5 700 Wörter & Abb.)

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ISOSSIMOW (A.), ABRAMOW (A.) und ELISSEJEWA (T.). — Die wirtschaftliche Auswirkung einer besseren **Ausnutzung der Ladefähigkeit der Waggons.** (1 200 Wörter & Abb.)

1953 **625** .62
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THIELE (K.). — Die künftige Entwicklung der **Strassenbahn.** (5 000 Wörter & Abb.)

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Das **zukünftige Stromsystem** für die elektrischen Bahnen in der Sowjetunion. (600 Wörter & Tafel.)

1953 **656** .21
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SCHABIKJAN (W.). — **Bestimmung des Wagenwiderstands beim Anziehen.** (3 000 Wörter & Abb.)

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1953 **625** .14
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PFOERTNER (W.). — **Wesentliche Kennzeichen der Wälzlager,** ihre Eigenschaften und deren Bedeutung für Vollbahnen. (4 000 Wörter & Abb.)

1953 **625** .26
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HORN (H.). — Neue Grundsätze und Organisation für die **Erhaltung der Motorschienenfahrzeuge.** (6 000 Wörter & Abb.)

1953 **656** .257 (43)
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BLUME (J.). — **Betriebserfahrungen im Gleiswechselbetrieb Bebra-Cornberg.** (6 000 Wörter & Abb.)

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TASCHINGER (O.). — **Kunststoffbelagbremse** unter besonderer Berücksichtigung der Scheibenbremse. (20 000 Wörter, Tafeln & Abb.)

1953 **656** .225
Eisenbahntechnische Rundschau, Dezember, S. 608.
KREIDLER (E.). — Betrachtungen über den Zweck und die Brauchbarkeit von **Güterzugbildungsunterlagen.** (2 500 Wörter & Tafeln.)

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DILLI (G.). — Der wandernde Engpass und sein Gefolge. Betrachtungen zur **Streckenleistungsfähigkeit zweigleisiger Bahnen.** (15 000 Wörter & Abb.)

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KIRSCHSTEIN (H.). — Die **neue Knorr-Druckluftbremse, Bauart « KE ».** Eine Einheitsform für Güter- und Reisezüge. Kontruktion und Wirkungsweise. (10 000 Wörter, Tafeln und Abb.)

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Die neue elektrische Bo'Bo'-Lokomotive E 10.003 der D. B.
KILB (E.) : I. Übersicht über die Entwicklung; SCHAAFF (H.) : II. Die elektrische Ausrüstung der Lokomotive E 10.003; LÖWENTRAUT (H.W.) : III. Der mechanische Teil der Lokomotiven E 10.003 bis 005. (10 000 Wörter & Abb.)

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REITER (M.). — Die **geschweissten Fahrgestelle** der elektrischen Lokomotiven Bo'Bo' Baureihe E 10. (2 500 Wörter & Abb.)

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Elektrische Bahnen, November, S. 277.
HEUMANN (H.). — **Grundzüge der Führung der Schienenfahrzeuge.** *(Fortsetzung).* (6 000 Wörter & Abb.)

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BUCKEL (R.). — Die **Beeinflussung von Fernmeldeanlagen bei 16 2/3 und 50 Hz** (2 000 Wörter & Abb.)

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WILKE (G.). — Neuer **vierachsiger Akkumulatortriebwagen** der Deutschen Bundesbahn. (4 000 Wörter & Abb.)

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MANZ (G.). — **Spaltkohlen beim Wechselstrombahnmotor.** (1 000 Wörter & Abb.)

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EBELING (H.). — **Fernsteuerung von Fahrleitungstrennschaltern.** (2 000 Wörter & Abb.)

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FEILL (W.). — Die **Regelung des Feldes bei Gleichstrom-Bahnmotoren,** insbesondere für dieselelektrischen Antrieb. (8 000 Wörter & Abb.)

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KLAUDY (P.). — Über eine **neue Erdkurzschluss-Anzeigevorrichtung.** (1 500 Wörder & Abb.)

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Diesel-electric locomotives for Western Australia. (1 400 words & figs.)

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The wear of electric railway rolling stock. (1 100 words.)

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98 mile radio keeps trains moving over the Cascade Mountains. (2 300 words & figs.)

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80 % of meets without stopping. Signaled sidings, nearly two miles long, with high speed turnouts permitting trains to hold 40 m.p.h. speed, are aids in making non-stop meets. (2 750 words & figs.)

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RANDALL (G.C.). — **Why so many empty car miles?** (1 350 words & figs.)

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Railway Age, January 4, p. 20.
How to prolong car-floor life. (900 words & figs.)

1954 **621** .332
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Adjustable catenary structures, (200 words & figs.)

1954 **385** (73)
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RANDALL (G.C.). — **The car distribution formula.** (1 700 words & figs.)

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Bensenville Yard today. (1 100 words & figs.)

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What price Diesel maintenance? (1 000 words & figs.)

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1954 **625** (73) & **625** .17 (73)
Railway Age, February 15, p. 24.
Findings of engineering staff. — What's new in A.A.R. Research-1-II. (4 000 words & figs.)

The Railway Gazette. (London.)

1953 **621** .132.6 (43)
The Railway Gazette, September 4, p. 262.
Krupp superheater tank engines. (1 300 words & fig.)

1953 **621** .33 (42)
The Railway Gazette, September 4, p. 263.
SEMMENS (P.W.B.). — **Eastern Region electric locomotive performance.** (2 000 words and figs.)

1953 **621** .335 (44)
The Railway Gazette, September 4, p. 265.
French high-speed Bo-Bo locomotives. (950 words & figs.)

1953 **621** .131.3 (42)
The Railway Gazette, September 11, p. 291; September 25, p. 346; October 16, p. 430.
POULTNEY (E.C.). — **British Railways class « 7 » locomotive tests.** (4 900 words & figs.)

1953 **621** .9 (42)
The Railway Gazette, September 11, p. 293.
Portable grinding equipment. (350 words & figs.)

1953 **625** .23 (0 (85)
The Railway Gazette, September 11, p. 295.
Lightweight coaches for the Peruvian corporation. (3 000 words & figs.)

1953 **621** .431.72
The Railway Gazette, September 18, p. 320.
Fire prevention in Diesel railcars. (1 400 words & figs.)

1953 **656** .25
The Railway Gazette, September 18, p. 321.
TOWERS (H.C.). — **Signal wiring practice in India.** (1 400 words & figs.)

1953 **621** .338 (494)
The Railway Gazette, September 18, p. 323
New « Red arrow » railcars in Switzerland. (650 words & figs.)

1953 **621** .132.1 (42)
The Railway Gazette, September 18, p. 324.
British Railways standard class « 2 » tank engine. (700 words & figs.)

1953 **621** .335 (43)
The Railway Gazette, September 25, p. 350.
German Federal Railways. — Mixed traffic Bo-Bo locomotives. (1 000 words & figs.)

Diesel Railway Traction

A Railway Gazette Publication. (London.)

1953 **621** .431.72 (45)
Diesel Railway Traction, September, p. 193.
Diesel traction on Italian State Railways. (4 500 words & figs.)

1953 **621** .431.72 (44)
Diesel Railway Traction, September, p. 205.
French Diesel-mechanical locomotives. (1 300 words & figs.)

1953 **621** .431.72 (45)
Diesel Railway Traction, September, p. 207.
Railcar working on Italian mountain lines. (2 800 words & figs.)

1953 **621** .431.72 (8)
Diesel Railway Traction, October, p. 222.
Diesel-electric locomotives for Uruguay. (1 300 words & figs.)

1953 **625** .212
Diesel Railway Traction, October, p. 225.
Mc. ARD (G.W.). — **Axle design and failures.** (4 000 words & figs.)

1953 **621** .431.72 (42)
Diesel Railway Traction, October, p. 235.
Diesel locomotive tests, British Railways. (1 200 words & figs.)

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1954 **621** .431.72 (73)
Railway Locomotives & Cars, January, p. 33.
Electro-motive announces ten new Diesel locomotive models. (1 250 words & figs.)

1954 **625** .212 (73)
Railway Locomotives & Cars, January, p. 37.
Wheels maintained exclusively by grinding. (1 150 words & figs.)

1954 **621** 438 (73)
Railway Locomotives & Cars, February, p. 47.
McGEE (P.A.). — **Gas turbines- and the motive-power problem.** (4 400 words, tables & figs.)

Railway Steel Topics.

1953 **669** (42)
Railway Steel Topics, Winter 53, No. 2, p. 4.
GRAIG (D.). — **Developments in the manufacture of steel for railway materials in the past- war period.** (3 500 words & figs.)

1953 **621** .131.2
Railway Steel Topics, Winter 53, No. 2, p. 12.
PATERSON (J.J.C.). — **The trend in the balancing of locomotives having two outside cylinders.** (2 900 words & figs.)

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1954 **656** .222.1 (42)
Railway Magazine, February, p. 109.
ALLEN (C.J.). — British locomotive practice and performance. (3 800 words, & table figs.)

1954 **656** .25 (494)
Railway Magazine, March, p. 157.
CRUMP (H.). — **Signalling in the Gotthard tunnel.** (2 000 words & figs.)

Railway Track and Structures. (Chicago.)

1953 **625** .173 (73)
Railway Track and Structures, September, p. 837.
AREA Committee inspects highly mechanised tie renewal gang. (1 500 words & figs.)

1953 **625** .144.4 (73)
Railway Track and Structures, September, p. 854.
Hydraulic rams for lining track. (750 words & figs.)

1953 **625** .17
Railway Track and Structures, December, p. 1158.
Track cleaner unloads material to form roadway alongside track. (1 100 words & figs.)

1953 **625** .142.2
Railway Track and Structures, December, p. 1173.
What 's being done toward getting more life from ties. (2 000 words & figs.)

In Danish (= 439.81).

Ingeniøren. (Copenhagen).

1953 **625** .142 (= 439.81) & **625** .144.1 (= 439.81)
ngeniøren, No. 32, p. 588.
PETERSEN (E.). — **Concrete sleepers and long rails on the Danish State Railways.** (1 900 words & fig.)

1953 **656** .21 : 656 (485 + 489) = (439.71)
ngeniøren, No. 34, p. 616.
ÅSTRÖM (T.). — **Some considerations on the traffic and the prospects concerning the proposed relation through the Sund.** (5 000 words & figs.)

In Spanish.

Boletin de la Asociación permanente del Congreso Panamericano de Ferrocarriles. (Buenos Aires.)

1954 **621** .431.72 (82)
oletin de la Asoc. perman. del Congreso Panameric. de Ferrocarriles, enero-febrero, p. 35.
Locomotores Diesel-electricas General Electric de 4400 H.P. de trocha ancha. Adquisiciones del Gobierno rgentino. (4 000 palabras & fig.)

Hormigón elastico. (Buenos Aires.)

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ormigón elastico, nº 12, diciembre, p. 10.
WETTSTEIN (H.). — Contribución para la discussión l problema de la **elasticidad del hormigón.** (3 000 palaas & fig.)

Ferrocarriles y Tranvias. (Madrid.)

1954 **625** .23
Ferrocarriles y Tranvias, enero, p. 3.
DURRANT (A.A.M.). — **Tendencias en la construcción de los vehiculos de transportes colectivos.** (5 000 palabras.)

1954 **625** .62 (73)
Ferrocarriles y Tranvias, febrero, p. 50.
MERRIL (E.D.). — **Explotación de los servicios publicos por un solo agente,** en los Estados Unidos (one-man car). (2 500 palabras & fig.)

1954 **625** .23 (494)
Ferrocarriles y Tranvias, marzo, p. 84.
HAMACHER (F.W.). — **Coches aligerados con caja tubular de acero** para los Ferrocarriles Federales Suizos. (2 000 palabras & fig.)

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LORENTE DE NO (C.). — Los metodos directos y los metodos de aproximaciones sucesivas de **calculo de éstructuras.** (12 000 palabras & fig.)

1954 **624** .2
Revista de Obras Públicas, enero, p. 11.
MENDIZABAL (D.). — Algunas novedades en los proyectos de **tramos metalicos.** (1 500 palabras & fig.)

In Italian.

Alluminio. (Milano.)

1953 **624** .245 (45)
Alluminio, luglio, p. 378.
STRUSS (R.). — **Nuovo carro ferroviario a tramogge autoportante di lega leggera** per trasporto di carbone fossile. (2 500 parole & fig.)

Giornale del Genio Civile. (Roma.)

1953 **624** & **691**
Giornale del Genio civile, ottobre, p. 578.
PAGANO (M.). — Studio statistico sperimentale su **travi in cemento armato precompresso.** (3 000 parole & fig.)

1954 **691**
Giornale del Genio civile, gennaio, p. 29.
CASTIGLIA (C.). — Su un **nuovo tipo di attrezzature per strutture precompresse.** (1 500 parole & fig.)

Ingegneria ferroviaria. (Roma.)

1953 **621** .33 (45)
Ingegneria Ferroviaria, dicembre, p. 891.
CUTTICA (A.). — La **trazione elettrica trifase** in Italia. (3 000 parole & fig.)

1953 **656** (45)
Ingegneria Ferroviaria, dicembre, p. 897.
SANTORO (F.). — **L'intervento dello Stato nei trasporti merci.** (10 000 parole.)

1954 **625** .1 (45) & **625** .2 (45)
Ingegneria Ferroviaria, gennaio, p. 3.
Dr. Ing. G. di RAIMONDO. — Uno sguardo all'**attività delle F.S. nell'anno 1953.** (10 000 parole & fig.)

1954 **621** .3
Ingegneria Ferroviaria, gennaio, p. 33.
RIGHI (R.). — L'Algebra dei **circuiti di commutazione.** (6 000 parole & fig.)

1954 **625** .14
Ingegneria Ferroviaria, gennaio, p. 47.
PELLIS (P.). — **Problemi di instabilità del binario ferroviario.** (5 000 parole & fig.)

1954 **625** .42 (45)
Ingegneria Ferroviaria, gennaio, p. 57.
Il problema della **Metropolitana** di Roma. (3 000 parole & fig.)

Trasporti Pubblici (Roma.)

1954 **621** .335 (44)
Trasporti Pubblici, marzo, p. 393.
I **locomotori monofasi a bassa frequenza** in 40 anni di trazione elettrica sulle Ferrovie tedesche. (500 parole & fig.)

In Netherlands.

Spoor- en Tramwegen. (Utrecht.)

1953 **656** .212.5
Spoor- en Tramwegen, nr 20, 1 October, p. 379.
PENTINGA (K.J.). — De **capaciteit van rangeeremplacementen.** (1 800 woorden & fig.)

1953 **625** .144.1
Spoor- en Tramwegen, nr 21, 15 October, p. 395.
NOYON (S.). — **Raillengte en voegwijdte.** (2 600 woorden & fig.)

1953 **625** .143.4
Spoor- en Tramwegen, nr 22, 29 October, p. 413.
DEENIK (J.F.). — Waarom en hoe steeds minder **voegen in het spoor?** (1 200 woorden & fig.)

1953 **656** .212.5
Spoor- en Tramwegen, nr 22, 29 October, p. 414.
PENTINGA (K.J.). — **Rangeermethoden.** (2 000 woorden & fig.)

1953 **621** .335 (44)
Spoor- en Tramwegen, nr 23, 12 November, p. 434.
NYMEYER (A.G.). — Nieuwe **electrische sneltreinlocomotieven** voor de S.N.C.F. (1 500 woorden & fig.)

1953 **625** .142.4
Spoor- en Tramwegen, nr 24, 26 November, p. 447.
DUNS (H.A.). — Het bouwen van spoor met **betondwarsliggers.** (2 000 woorden & fig.)

1953 **625** .143
Spoor- en Tramwegen, nr 24, 26 November, p. 455.
KRABBENDAM (G.). — Volgens welke richtlijnen bepaalt men het **spoorstaafprofiel** bij nieuwe aanleg of bij spoorstaafvernieuwing? (1 600 woorden.)

In Norwegian (= 439.82).

Teknisk Ukeblad. (Oslo.)

1953 **624** .21 : **656** (485 + 489) (= 439.82)
Teknisk Ukeblad, No. 29, p. 623.
ARILD (A.). — **Bridge-tunnel through the Sund.** (1 500 words & figs.)

In Portuguese.

Técnica. (Lisboa.)

1953 **721** .1
Técnica, nº 230, março, p. 357.
NASCIMENTO (U.). — Determinação do grau de encastramento dos **maciços de fundação.** (800 palavras & fig.)

1953 **624** (0
Técnica, nº 235, outubro, p. 15.
BRAZÃO FARINHA (J.S.). — **Cálculo de estruturas hiperstaticas.** (4 000 palavras & fig.)

In Swedish (= 439.71).

Järnvägs-Teknik. (Statsbaneingenjören) (Stockholm.)

1953 **625** .142.4 **(485)** (= 439.71)
Järnvägs-Teknik, No. 6, p. 170.
FOGELBERG (T.). — **Concrete sleepers.** (4 300 words & figs.)

1953 **625** .245 : **625** .172 = 439.71
Järnvägs-Teknik, No. 6, p. 179.
SCHÄDER (S.) & NORD (P.). — **Wagons to measure the construction of the permanent way.** (3 900 words & figs.)

Teknisk Tidskrift. (Stockholm.)

1953 **656** .25 : **625** .42 **(485)** (= 439.71)
Teknik Tidskrift, No. 31, p. 625.
BOBERG (I.). — **Signalling system of the Stockholm Underground Railway.** (3 800 words & figs.)

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